FROM EXPERIMENTATION TO ADOPTION

DEVELOPING THE RIGHT VALUE PROPOSITION FOR CBDCs IN THE DIGITAL MONEY RACE

OCTOBER 2025

QUINLAN &ASSOCIATES

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EXECUTIVE SUMMARY

Over the past decade, CBDCs have moved to the top of many central banks' strategic agendas, growing from just 3 projects in 2016 to 149 by August 2025. While many initiatives have advanced from research to proof-of-concept ("PoC") and pilot, there is a clear "difficulty curve": progress slows sharply beyond the pilot stage. As of the time of writing, only three CBDCs have been fully launched (excluding ZiG, which is a gold-backed digital currency).

The majority of CBDC explorations (~70%) are focused on retail CBDCs ("rCBDCs"), where several trends raise concerns regarding future adoption:

- **Cancellation:** Some jurisdictions have abandoned rCBDC projects due to public opposition (e.g., Canada) or limited perceived value (e.g., Denmark, Japan). For many countries, more immediate and tangible value was seen in modernising existing payment systems vs. launching a new digital currency.
- **Deferment:** Other jurisdictions have paused rCBDC exploration, with Singapore seeing little immediate benefit, the Philippines shifting its focus to wholesale CBDCs ("wCBDCs"), and South Korea redirecting its focus to stablecoins. These trends highlight the fact that strategic alignment with domestic priorities and payment ecosystem maturity is critical before committing to full exploration of rCBDCs.
- **Minimal Uptake:** Even among jurisdictions that have launched rCBDCs, adoption remains very low, with the Bahamas' Sand Dollar, Nigeria's eNaira, and Jamaica's JAM-DEX representing less than 1% of currency in circulation. Early pilots in major economies show similar patterns with limited user uptake.

Several factors continue to weigh on rCBDC adoption, including marginal user benefits from rCBDCs in already mature digital payment ecosystems, behavioural inertia as users may need to adjust their entrenched payment habits and venture into uncharted territories, and concerns around privacy and security, among others. In contrast, wCBDCs showcase clearer adoption drivers, including well-defined user propositions, continuity with existing practices, and risk reduction.

Lessons from underperforming CBDCs, as well as other successful forms of digital money (e.g., stablecoins and tokenised deposits) can offer valuable insights for the next generation of CBDCs. Central banks should look to clearly identify existing pain points, build a robust business case, ensure user-centric CBDC design (spanning legal, regulatory, and technical aspects), and secure stakeholder buy-in pre-launch. This includes setting incentive schemes to drive initial uptake and familiarity (as seen with Ethena's USDe), developing robust partnerships to expand utility (as seen with Circle's USDC), and addressing risk concerns through a two-tiered intermediary model leveraging trusted banking partners (as seen with HSBC's tokenised deposits).

Ultimately, we believe that the path to more widespread and successful CBDC adoption requires a combination of technical innovation with thoughtful ecosystem design and clear value propositions. By following this roadmap, CBDCs can evolve from experimental projects into effective policy and market instruments, ultimately embedding themselves alongside stablecoins and tokenised deposits as widely adopted instruments with their own clear positioning in the digital economy.

SECTION 1

CBDC DEVELOPMENTS

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RAPID GROWTH OF CBDC PROJECTS

KEY TAKEAWAYS

CBDC projects have grown at a considerable pace in recent years. What was once a niche area of exploration has now become a global policy and innovation priority for many central banks across the globe.

Most projects have focused on retail CBDCs (70%), reflecting policymakers' priorities around financial inclusion, payment efficiency, and domestic market resilience.

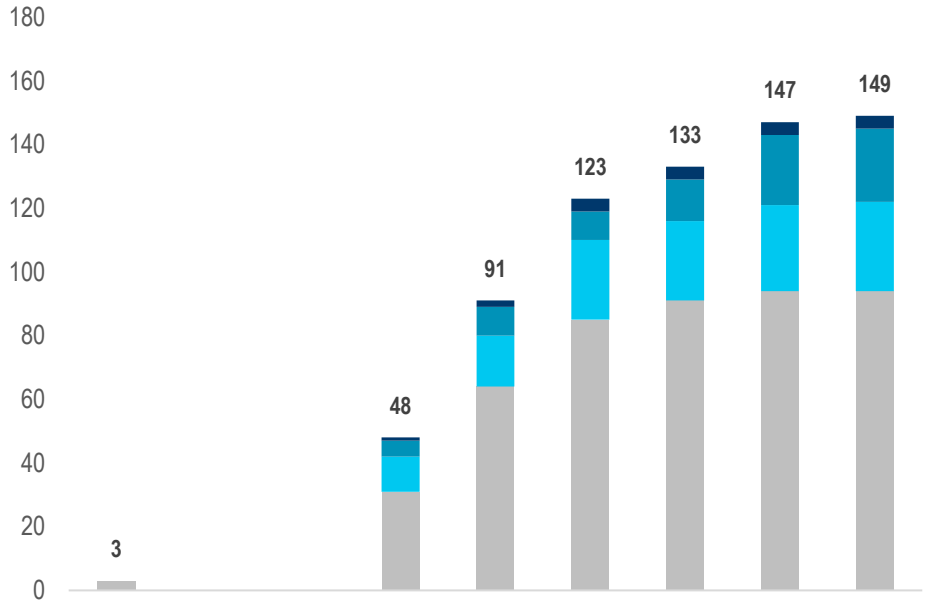
Wholesale CBDC projects, though less in number, are attracting increasing attention, given their potential to transform cross-border settlement and wholesale market infrastructure.

Over the past five years, in particular, momentum has shifted from theory to practice, with many jurisdictions moving beyond early-stage research into PoC testing and pilots. However, full-scale launches remain limited and have essentially stagnated since 2022.

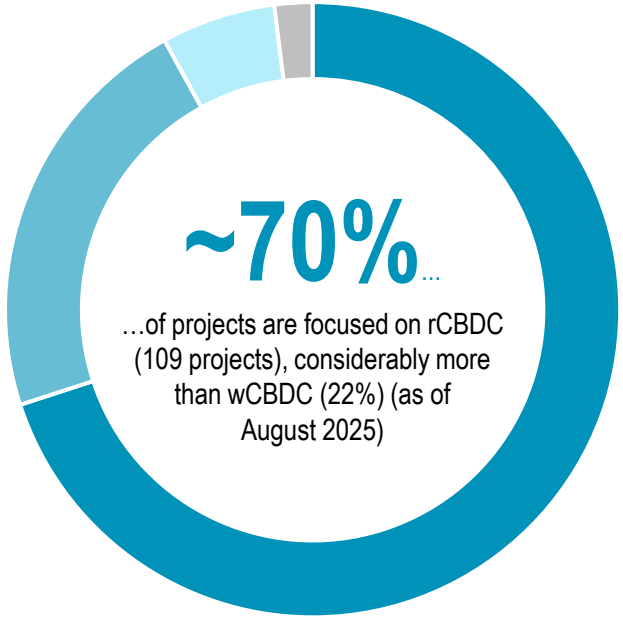
While CBDC initiatives are rapidly gaining traction, with over one-third (36%) of CBDC projects advancing beyond research into active development and pilot stages, actual launches remain limited

CBDC Projects

Cumulative,[1] January 2016 – August 2025



Cumulative # (By Stage)	2016	2020	2021	2022	2023	2024	2025
Launched	-	1	2	4	4	4	4
Pilot	-	5	9	9	13	22	23
PoC	-	11	16	25	25	27	28
Research	3	31	64	85	91	94	94



[1]Excluding CBDC projects that have been cancelled, [2]Examples include ZiG, a digital currency backed by physical gold reserves by Zimbabwe and Project Stella by the European Central Bank and Bank of Japan exploring the use of distributed ledger technology ("DLT") on financial market infrastructures ("FMIs")

Source: CBDC Tracker, Quinlan & Associates analysis

RECENT CBDC DEVELOPMENTS

KEY TAKEAWAYS

Many major economies are actively exploring CBDC innovations with shared objectives, namely, addressing inefficiencies in traditional payment systems and promoting inclusion by extending access to modern payment benefits for underserved communities.

Together, these priorities underscore the potential of CBDCs – not only as a tool to modernise payment infrastructure, but as a means of promoting societal good and fostering greater financial inclusion.

Given the significance of these outcomes, central banks are progressing deliberately, taking time to develop formal opinions, implement phased extensions, and issue periodic progress reports before committing to full-scale launches. This measured pace ensures that potential risks – ranging from operational failures to unintended economic consequences – are carefully managed, important in laying a strong foundation for broader adoption.

Progress remains measured among central banks in major economies, with developments guided by formal opinions, phased extensions, and periodic progress reports rather than immediate urgency

Recent CBDC Developments

Retail, Wholesale, and Both

RETAIL ONLY ← → WHOLESALE ONLY ← → RETAIL AND WHOLESALE

e-CNY Pilots (PBC[1])	Project Helvetia (SNB[2])	Project mBridge (BIS[3])	Digital Dirham (CBUAE[4])	Digital Euro (ECB[5])
Guiding Opinions on Effectively Completing "Five Major Financial Articles" (Mar 2025)	*Announcement on extension and expansion of Project Helvetia (Jun 2025)*	*Announcement on Project mBridge reached the minimum viable product ("MVP") stage (Nov 2024)*	*Report on digital dirham progress, plans, and policy considerations (Jul 2025)*	*The third progress report on the digital euro preparation phase (Jul 2025)*
KEY DEVELOPMENTS				
The Guiding Opinions state that e-CNY research and application will continue, with a focus on **enabling diverse use cases**	SNB will extend Project Helvetia by a year and expand it to include **settlement of tokenised assets** with central bank money	Project mBridge, a multi-CBDC cross-border payment platform, **reached the MVP stage** in mid-2024	In 2024, CBUAE issued its first Digital Dirham for cross-border payments and **plans full retail and wholesale launches**	Under ECB's innovation platform, about 70 participants have tested **digital euro features** and explored potential **use cases**
MOTIVATIONS				
Build an **easy-to-use, secure, and efficient** digital payment system / infrastructure	**Securely and efficiently** settle transactions with tokenised assets	**Tackle inefficiencies** in cross-border payments and address **financial inclusion** concerns	Drive **innovation and financial inclusion**, and boost the **efficiency** of payment systems	Enhance **inclusion and accessibility**, and strengthen ecosystem integration

[1]People's Bank of China, [2]Swiss National Bank, [3]Bank for International Settlements, [4]Central Bank of the United Arab Emirates, [5]European Central Bank

Source: CBUAE, ECB, PBC, BISIH, SNB, Quinlan & Associates analysis

SECTION 1.1

RETAIL CBDC

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PROJECT DEFERMENTS / CANCELLATIONS

KEY TAKEAWAYS

Several countries have ruled rCBDCs out entirely: Canada has shelved its plans after public opposition and unclear value proposition. Denmark abandoned rCBDC issuance after research showed it would add little to its already efficient system. Fiji ruled out rCBDCs to focus on modernising its national payment system, citing uncertainty about its future relevance. Japan cancelled its rCBDC project due to low public interest and high digital payment adoption.

Other countries have taken a cautious approach to rCBDCs: Singapore has publicly deferred rCBDC exploration, citing already efficient retail payment systems. South Korea paused its rCBDC pilot, citing high costs and lack of a clear commercial plan, and is now prioritising the regulation of won-backed stablecoins. Meanwhile, the Philippines chose to issue wCBDCs instead of rCBDCs, aiming to offer a safer, regulated alternative to unregulated cryptocurrencies.

Numerous countries have either canceled or deferred their exploration of rCBDCs, with key reasons being the lack of value add to existing payment ecosystems, as well as their associated risks

Cases of Cancellation / Deferment

Retail CBDC

	COUNTRY CASES	DESCRIPTION
PROJECT CANCELLATION	**Canada** *Shelved the Idea of an rCBDC*	In 2024, the Bank of Canada decided to shelve plans for an rCBDC after years of research, including a large-scale consultation in 2022 that revealed broad public opposition (~86% of respondents). Instead, the bank shifted its focus toward broader payment system research and policy development
PROJECT CANCELLATION	**Fiji** *Ruled out the issuing of rCBDCs*	At the end of 2024, the Reserve Bank of Fiji ruled out issuing rCBDCs for the immediate future, instead shifting its focus to modernising the country's National Payment System to improve its efficiency and security. Therefore, it is difficult to predict with certainty the future of rCDBCs in Fiji
PROJECT CANCELLATION	**Denmark** *Abandoned the idea of issuing rCBDCs*	Denmark was one of the first countries to explore issuing a CBDC, with its central bank showing interest in 2016 and studying the idea of a digital krone. However, after a year of research, the central bank decided not to proceed, concluding that a CBDC would add little value to Denmark's already secure and efficient payment system
PROJECT CANCELLATION	**Japan** *Scrapped rCBDC Plans*	The Bank of Japan ("BoJ") has cancelled its rCBDC project, citing low public interest. After completing initial testing phases, the BoJ decided against launching a pilot program, as many Japanese citizens already use efficient digital payment systems and internet banking, reducing the demand for rCBDC
PROJECT DEFERMENT	**Singapore** *No Pressing Need for an rCBDC*	In 2021, the Monetary Authority of Singapore ("MAS") shared their view that retail payments are generally competitive, efficient, and cheap, with several existing initiatives already in place to effectively address frictions and costs. As such, they saw no immediate or pressing need for an rCBDC
PROJECT DEFERMENT	**Philippines** *Focus on wCBDC instead of rCBDC*	The Bangko Sentral ng Pilipinas announced in 2024 that it will prioritise the introduction of wCBDCs instead of rCBDCs, as rCBDCs could potentially bring in regulatory disintermediation, significantly increase the central bank's operational footprint, and possibly worsen the severity of possible bank runs
PROJECT DEFERMENT	**South Korea** *Paused rCBDC project*	Bank of Korea has paused the second testing phase of its rCBDC (initially scheduled for Q4 2025) due to high costs and an unclear commercial strategy. Instead, it is shifting its focus to regulating and promoting won-backed stablecoins to strengthen the country's monetary sovereignty

Source: HKTDC Research, Digital Watch, the Fiji Times, Cointelegraph, Investing News, Quinlan & Associates analysis

KEY ADOPTION BARRIERS

KEY TAKEAWAYS

Even for countries that have entered pilot stages or fully launched rCBDCs, adoption lag well behind expectations (with rCBDC circulation well below 1% of the total currency in circulation) due to the following factors:

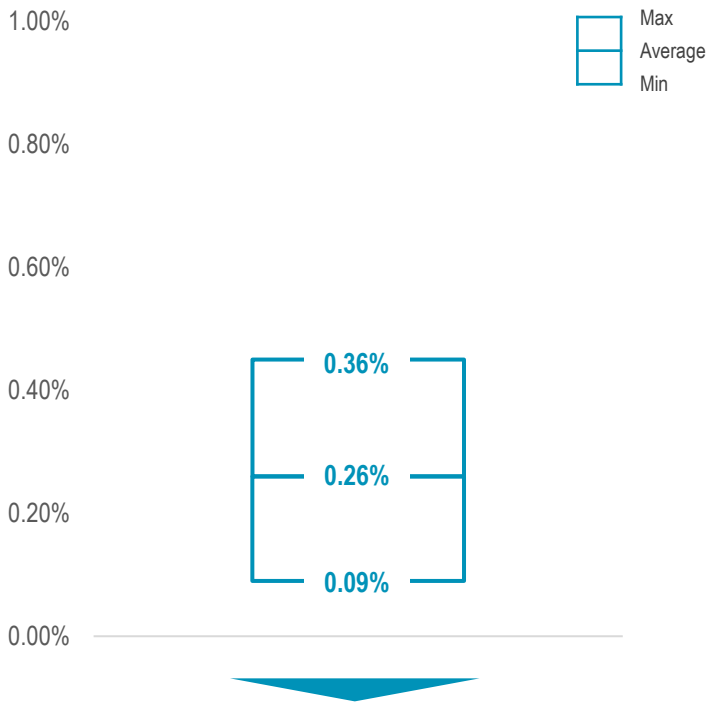
1. **Marginal User Benefits:** While there are various benefits that rCBDCs can deliver to merchants and governments, their value to individual users remains less compelling; and
2. **Behavioural Inertia:** While there are potential benefits to rCBDCs, users may resist changing their established habits unless there is a compelling reason to do so; and
3. **User Concerns:** Intermediaries (e.g., financial institutions) and end-user individuals have various concerns (e.g., privacy), which they may regard as not a worthy trade-off for the benefits on offer.

As the perceived trade-offs in privacy, trust, and financial stability loom large vs. the incremental benefits, resistance to rCBDCs persists.

Countries piloting / having launched rCBDCs face suboptimal adoption caused by three primary resistance factors: (1) marginal user benefit, (2) behavioural inertia, and (3) user concerns

Launched rCBDCs

% of Currency in Circulation (i.e., cash component of M0), 2024



Even with nationwide launches and sizeable government investments, adoption remains subdued among launched rCBDCs (excluding ZiG, a gold-backed token), with rCBDC circulation **well below 1% of the total currency in circulation**

Resistance Factors

Retail CBDC

Resistance Factors

Marginal User Benefits

For most individuals, especially in developed markets, domestic payments are already instant, free, and convenient, while cash, loyalty apps, and e-wallets address their other key needs

Behavioural Inertia

Payment habits are deeply entrenched, and without a clear "step-up" in convenience or cost savings, consumers and merchants alike may see little reason to adopt rCBDCs

User Concerns

Fears around privacy and government surveillance risks weigh heavily on consumer trust, while banks worry about disintermediation

Source: Forbes, Ledger Insights, Digital Euro Association, Cassels, Coin Telegraph, Reuters, Naira Metrics, Kansas City Fed, Morningstar, Quinlan & Associates analysis

MARGINAL USER BENEFITS (1/3)

KEY TAKEAWAYS

Central banks are experimenting with various CBDC use cases designed to address specific market frictions and policy priorities. In particular, retail use cases are focused on everyday users, consumers, and businesses, retail CBDCs support financial inclusion, consumer convenience, resilience, and adoption in the real economy. Through programmability, governments can design money with specific attributes, such as offline capabilities for unbanked communities, disbursements that are time- or purpose-bound (e.g., food or medical subsidies), and digital rewards.

Given the wide range of use cases being explored, central banks must carefully evaluate which use cases deliver real value and align with their policy objectives.

A wide range of retail use cases are currently being explored by central banks across the world in an effort to evaluate which applications deliver real-world value

Use Cases
Retail CBDC

USE CASES	EXAMPLES
1 **DOMESTIC PAYMENTS (INCLUDING OFFLINE PAYMENT)** Enable P2P and P2M transactions with and without internet connectivity	*Test the use of e-HKD in a mobile SIM card for offline payments by a bank and telecommunications provider under Phase 2 pilot*
2 **ASSET TOKENISATION AND SETTLEMENT** Facilitate instant settlement of stocks, bonds, etc.	*Test tokenised asset settlement via its Helvetia pilot, focusing in particular on government bond issuance*
3 **GOVERNMENT DISBURSEMENTS** Distribution of subsidies, welfare, and emergency relief to residents	*Completed the first Digital Dirham retail pilot involving the "Smart Social" use case (i.e., food subsidy distribution)*
4 **DIGITAL REWARD / LOYALTY PROGRAMMES** Issue, redeem, or combine digital rewards (e.g., miles, retail points)	*Has an industry-first application that allows SMEs[1] to create their own reward schemes powered by CBDC*
5 **TOURISM SPENDING** Provide tourists with temporary wallets to transact with local merchants	*Tourists can set up a wallet with authorised FIs[2] and purchase Sand Dollars to be spent locally*
6 **INTERNATIONAL REMITTANCES** Fund transfer by individuals, such as migrant workers to families	*Approved the use of eNaira (i.e., CBDC) for inbound remittances, making it cheaper and more efficient*

Source: CBUAE, HKMA, BIS, Ledger Insights, Quinlan & Associates analysis

MARGINAL USER BENEFITS (2/3)

KEY TAKEAWAYS

In jurisdictions with well-established instant payment systems, digital wallets, and card services, as well as high mobile payment penetration, the incremental value of rCBDCs is limited. In such contexts, the primary benefits of rCBDCs tend to accrue to merchants and governments, while consumers perceive little added value, leading to minimal public adoption and, in some cases, outright opposition.

Conversely, in jurisdictions where instant payment systems, banking services, or digital wallets are not widespread and cash remains dominant, rCBDCs can offer a meaningful channel for the unbanked population to access digital payments and financial services. In these cases, rCBDC adoption can deliver value to individuals while also benefiting merchants and governments.

When developing rCBDCs, central banks need to carefully assess their existing domestic infrastructure and processes, identifying use cases that provide real value to different stakeholders to drive adoption organically.

The presence of instant, low-cost domestic payment systems in many countries has left little room for rCBDCs to deliver additional value

Value Proposition
Retail CBDC

Extent of Value Added: High ▮▮▯▯▯ Low ▭ Unclear Value Proposition

Use Cases	DOMESTIC PAYMENTS	DIGITAL REWARD & LOYALTY PROGRAMMES	GOVERNMENT DISBURSEMENTS
Example 1	*In Mainland China, domestic digital P2P and P2M payments have already achieved a high penetration rate of 92.3%*	*India's reward programmes are quite advanced, with personalised rewards offered by large enterprises and some SMEs on mobile apps*	*Jamaica has been piloting Gov Payout (a digital platform for fund disbursement via bank transfer) and the use of the island's first digital wallet, Lynk*
Individuals	▮▯▯▯▯ Since individuals **already enjoy convenient transfers**, the incremental value of the e-CNY is limited	▮▮▯▯▯ With established digital reward programmes in place, the **value proposition of an rCBDC is constrained**	▮▯▯▯▯ There are sufficient channels for disbursement, and JAM-DEX would serve **as a medium of exchange** for Lynk
Others	▮▮▯▯▯ e-CNY could help merchants **reduce costs paid to the e-wallet providers and payment aggregators**	▮▮▮▮▯ Small merchants could tailor and run their **own reward programmes** without additional infra. investments	▮▮▯▯▯ Governments can **leverage programmability** to enforce conditions for the use of coupons / vouchers
Example 2	*Niger's payment landscape is heavily cash-based, with no IPS,[1] and only 5.4% of the adult population owns a mobile money account*	*In Egypt, >60% of adults remain unbanked and mobile wallet penetration sits at below 50%, with little foundation for digital rewards to grow*	*During COVID-19, the first tranche of the Philippines' Social Amelioration Programme relied on manual processing and physical cash delivery*
Individuals	▮▮▮▮▮ An rCBDC could potentially **improve financial inclusion** and accessibility to digital payment rails	▮▮▮▮▮ An e-pound could provide a **direct, government-backed digital payment option** with integrated digital rewards	▮▮▮▮▮ Individuals, especially the unbanked, could benefit from a more **streamlined welfare collection process**
Others	▮▮▮▮▯ An rCBDC could also help merchants **reduce cash-handling risks** and improve settlement efficiency	▮▮▮▮▯ Merchants could **reach unbanked individuals** who hold e-pound wallets and offer them programmable incentives	▮▮▮▮▯ The government could leverage programmability to **distribute welfare in a more targeted manner**

The value add of rCBDC for individuals depends largely on the existing domestic payment landscape and the availability of substitutes. Central banks should assess their current environment to determine whether rCBDC use cases can provide meaningful benefits

[1]Instant Payment System

Source: Sina, Jamaica Gleaner, Global Government Fintech, Jamaica Information Service, RBI, finextra, Ecofin agency, Transfi, MOIS, World Bank, The Times of India, Quinlan & Associates analysis

MARGINAL USER BENEFITS (3/3)

KEY TAKEAWAYS

Similar to domestic payments, digital rewards and loyalty programmes, and government disbursements, use cases such as offline payments and tourism-related spending hold limited appeal for individuals but deliver greater benefits to merchants. This warrants a think-around approach to encourage adoption, including the specific groups to target.

Additional use cases can be considered when existing market solutions are inefficient, such as limited functionality, long processing and settlement times, or high costs. Examples include tokenised asset settlement, international remittance, parent-child sub-wallets, and tax payments, which are currently being explored or implemented in certain jurisdictions.

Ultimately, the key implication is clear: central banks must prioritise use cases that provide tangible value-add over the status quo while directing awareness and adoption efforts toward the stakeholder groups that stand to benefit the most from rCBDCs.

The value rCBDCs can deliver to different stakeholders depends largely on the state of current payment processes, especially in terms of the key pain points faced by individuals and merchants

Value Proposition
Retail CBDC

OFFLINE PAYMENTS

Individuals	The additional value for individuals is limited, as **cash already provides a universal and reliable offline payment method**
Merchants	Merchants may benefit in regions where handling cash is costly or risky, due to factors such as **security, storage, and reconciliation**

TOURISM SPENDING

Individuals	The **impact on residents is limited**, given that the main benefits accrue to tourists instead
Merchants	Merchants can more easily accept foreign rCBDCs, **reducing FX friction** and card fees in tourism-heavy economies

The value an rCBDC adds for individuals is generally limited, with merchants being the primary beneficiaries

Additional Use Cases
Retail CBDC

ASSET TOKENISATION & SETTLEMENT

Suitable Scenarios	The current settlement process is inefficient, involving **prolonged processing times and high costs**
Example	*The HKMA[1] is testing the settlement of tokenised assets (e.g., tokenised funds and deposits) using e-HKD to **enhance efficiency and security of settlements***

INTERNATIONAL REMITTANCE

Suitable Scenarios	Many individuals are working overseas and incurring **high remittance fees, delayed transfers** due to banking hours, and **do not have bank accounts**
Example	*Nigeria's e-Naira has been approved for this use, allowing recipients to receive diaspora funds **directly into their eNaira digital wallets free of charge***

PARENT / CHILD SUB-WALLET

Suitable Scenarios	Current digital wallets on the market **lack sufficient functionality** (e.g., have age restrictions) to enable children to use them
Example	*The CBUAE is considering allowing parents to set up sub-wallets for their children, incorporating **programmable allowances / spending controls via smart contract***

TAX PAYMENTS

Suitable Scenarios	The current tax payment process **incurs fees** when third-party payment providers are involved
Example	*Using the e-CNY, individuals can pay tax with **zero transaction cost, real-time settlement, and legal safeguards** without the involvement of third-party PSPs[2]*

Other retail use cases with direct benefits to individuals could be explored to address existing inefficiencies in the market

[1]Hong Kong Monetary Authority, [2]Payment Service Providers

Source: CBUAE, HKMA, Sina Finance, Ledger Insights, Quinlan & Associates analysis

BEHAVIOURAL INERTIA (1/2)

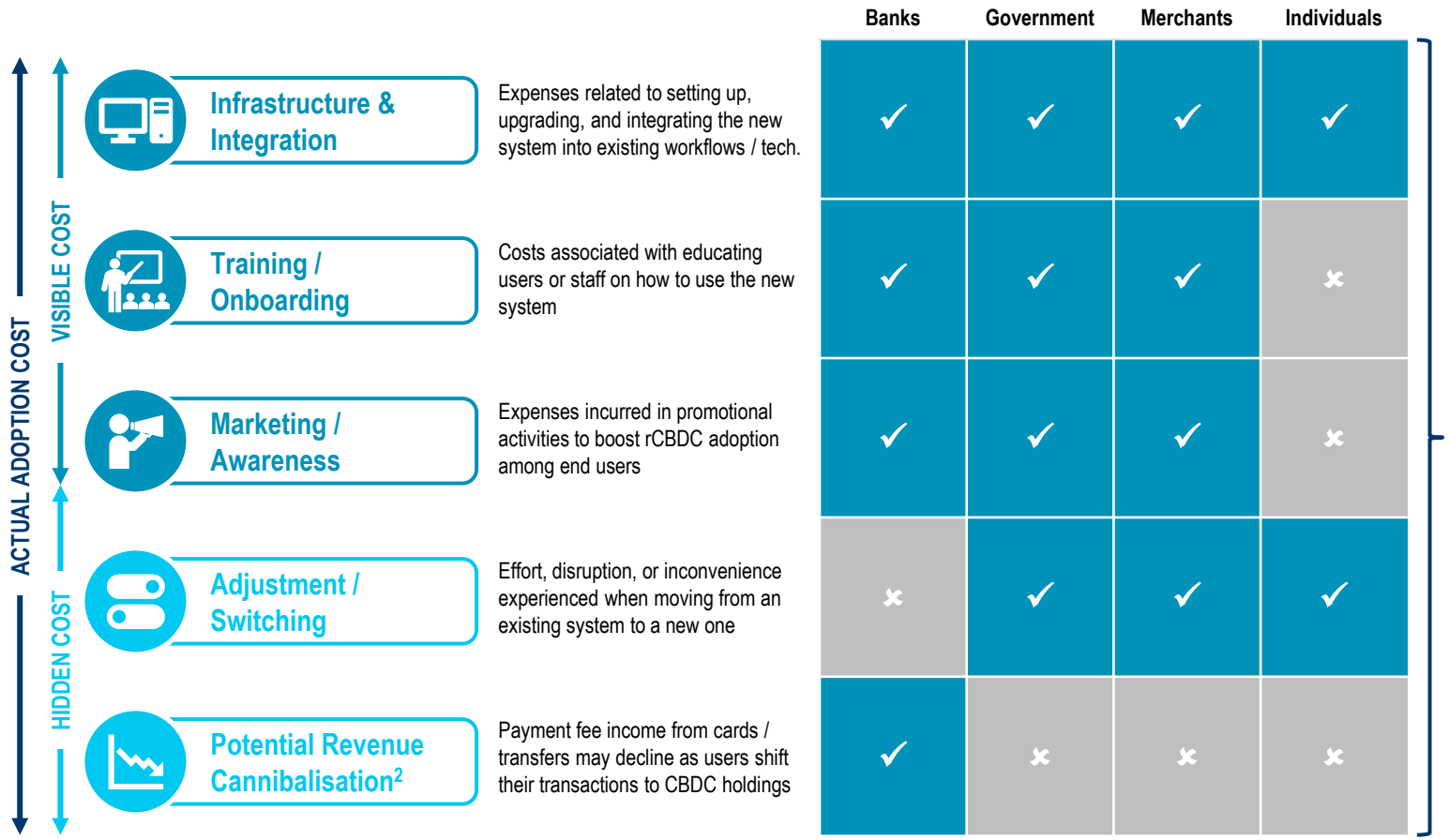
KEY TAKEAWAYS

While adoption lags may result from rCBDCs offering marginal user benefits, this may be compounded by significant behavioural inertia, creating visible and hidden costs for both intermediaries and end users:

- **Visible Costs:** Banks and merchants face significant upfront expenses to integrate rCBDCs into their systems, ranging from infrastructure upgrades, POS[1] terminal enhancements, and compliance adjustments, to staff training and consumer education campaigns. Without a clear business case or tangible return, intermediaries may hesitate to make these investments. For consumers, the shift to a purely digital interface could mean additional costs, such as upgrading devices and increasing data usage; and
- **Hidden Costs:** Beyond tangible costs, the more detrimental barriers are often the hidden ones, such as disruptions of payment habits and the potential cannibalisation of bank revenues, which undermine the case for rCBDCs.

In practice, the adoption of rCBDCs comes with a variety of visible and hidden costs that can hinder more widespread, sustainable adoption

Behavioural Inertia
Adoption Cost by Stakeholder Groups



IMPLICATIONS:
These visible and hidden costs not only slow down adoption but also risk entrenching resistance unless clear incentives, tangible benefits, and strong network effects are established to offset them

[1]Point of Sale, [2]Dependent on the design features of CBDC, including interest rate on CBDC balances, fee imposition, and interoperability
Source: Jamaica Information Service, Central Bank of The Bahamas, CBN Digital Commons, The State Council of the People's Republic of China, Quinlan & Associates analysis

BEHAVIOURAL INERTIA (2/2)

KEY TAKEAWAYS

To alleviate adoption costs, central banks have introduced various incentive schemes. However, these efforts have fallen short in driving meaningful adoption due to two key limitations:

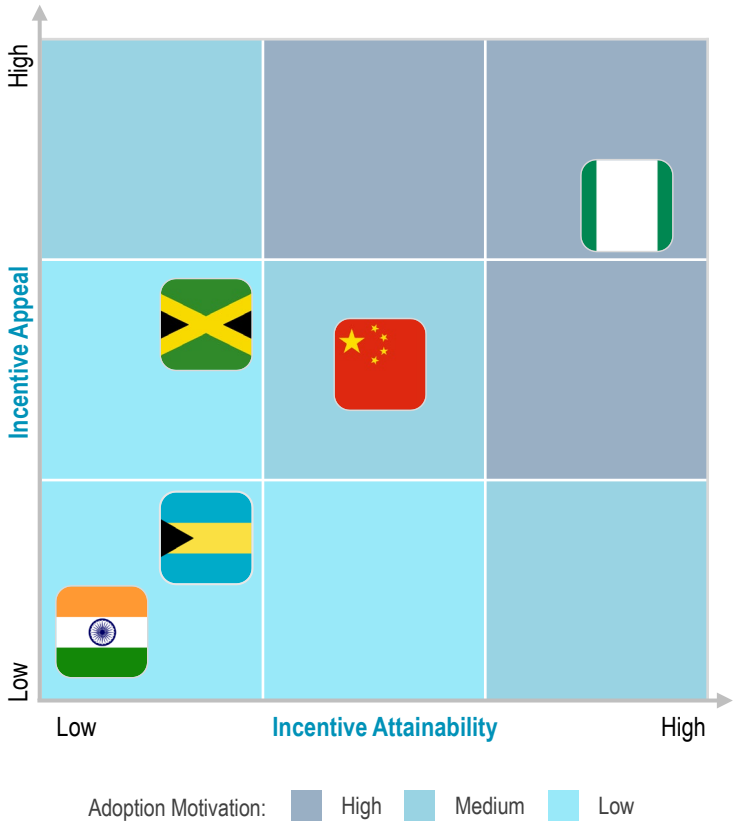
- **Limited Appeal**: Although bonuses are offered to merchants or customers, amounts are typically small and one-off in nature, garnering limited public interest; and
- **Low Attainability:** Most incentives rely on randomly selected or first-come, first-served models, meaning only a small proportion of users received the bonuses, underscoring their limited accessibility and effectiveness.

While such measures may temporarily lift rCBDC usage, effects are short-lived. The Bahamas has already discontinued its incentives, while Jamaica saw adoption drop sharply once its incentive programs ended.

Although some central banks have introduced various incentives to promote rCBDC adoption, most of them are neither appealing nor easily attainable, offering little real motivation for user adoption

Incentive Schemes
Retail CBDC

Level of Appeal / Attainability: High Medium Low Lack of Adoption Motivation Geographies



	Country	Incentives	APPEAL: Amount	APPEAL: Frequency	APPEAL: Scale	APPEAL: Overall	ATTAINABILITY: Conditions	ATTAINABILITY: Overall
GOVERNMENT-LED	China	• Consumption Voucher	RMB 50-200 (~USD 6.9-28.0)	1~3 rounds in each pilot city	Customers who open e-CNY wallets	Medium	Randomised via lottery draw	Medium
GOVERNMENT-LED	Bahamas	• Top-up • Rebate	BSD 20 (~USD 20.0) BSD 5 (~USD 5.0)	One-off	Customers	Low	First 100 customers Spend BSD 18 / More	Low
GOVERNMENT-LED	Nigeria	• Transaction Bonus / Discount	5% of the transaction value	Per transaction	Merchants and customers	High	Upon any purchases	High
GOVERNMENT-LED	Jamaica	• Upfront Bonus	JMD 2,500 (~USD 15.6) JMD 25,000 (~USD 156.1)	One-off	Customers Merchants	Medium	First 100 customers / merchants	Low
PRIVATE-SECTOR LED	India[1]	• Cashback • Reward Points	Rs 150 + Rs 100 (USD 2.8 worth of voucher[2])	1-month offer period	Customers	Low	Activate the e-Rupee app and does 20 transactions	Low

[1]Incentives to encourage the use of the Digital Rupee are rolled out by private banks in India instead of the Reserve Bank of India, taking the example of the Federal Bank's cashback / reward points offer for its customers, [2]Voucher for use at Swiggy, an Indian online food ordering and delivery app

Source: The People's Bank of China, Central Bank of The Bahamas, Central bank of Nigeria, Jamaica Information Service, Mint, Federal Bank, Quinlan & Associates analysis

USER CONCERNS

KEY TAKEAWAYS

There are several concerns that hinder adoption, originating from the following stakeholders:

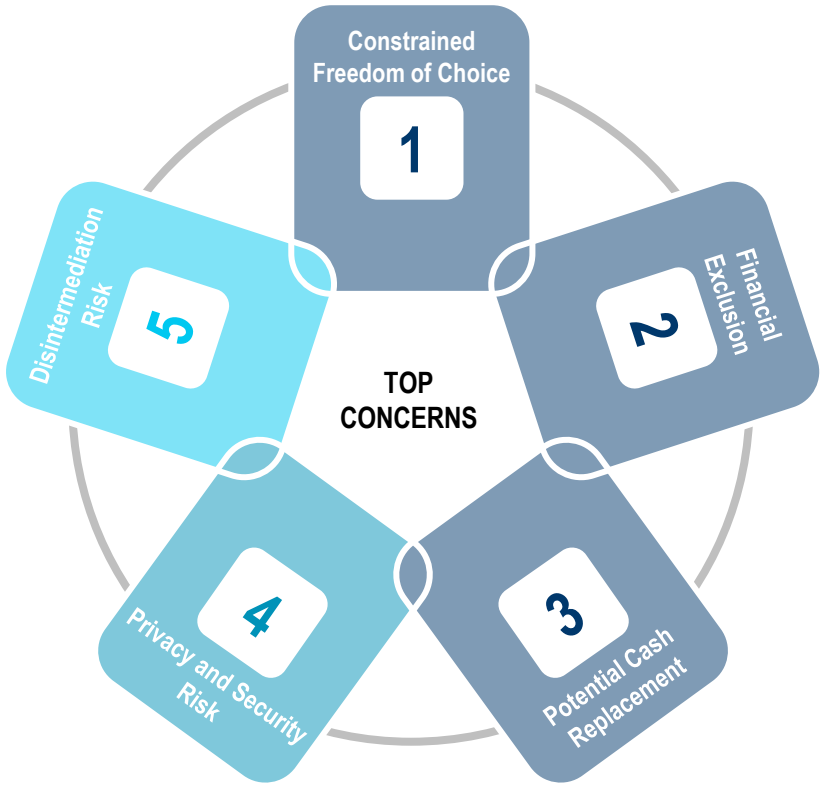
1. **End Users**: Individuals and merchants worry about constrained freedom of choice in how they manage and spend money, greater financial exclusion from digital-only interfaces, and that CBDCs could replace cash; and
2. **Intermediaries:** The migration of funds into CBDCs could erode traditional deposit bases, limiting banks' capacity to lend and potentially affecting profitability. This disintermediation risk could weaken banks' role in the payment ecosystem and reduce their influence over financial flows; and
3. **Both:** Across both groups, privacy and security concerns amplify hesitancy. The potential for transaction data to be monitored, tracked, or misused raises questions about surveillance and the protection of financial information.

Collectively, these concerns have weighed on the acceptance and usage of rCBDCs.

In additional to marginal user benefits and behavioural inertia, various concerns regarding the rollout of rCBDCs have been voiced by individuals and merchants

User Concerns
Retail CBDC

End Users (Individuals and Merchants) | Intermediaries (Banks) | Both End Users and Intermediaries



1 Constrained Freedom of Choice

Since rCBDCs are issued and controlled by central banks, there are fears over concentrating power and **reducing autonomy in managing and using money**

BANK OF CANADA / BANQUE DU CANADA

19% of respondents are concerned that CBDCs will give too much power to the government *(2023 Digital Canadian Dollar Public Consultation Report)*

2 Financial Exclusion

If rCBDCs rely on digital platforms, they **may exclude populations** with low digital literacy (e.g., elderly) or those without reliable internet access

Bank of England

Some respondents highlight the risk of digital exclusion where it is inaccessible for certain communities *(2024 Responses to the Digital Pound Consultation Paper)*

3 Potential Cash Replacement

Users worry that **physical cash could be phased out** (e.g., merchants stop accepting it), reducing their ability to transact in situations where anonymity is preferred

EUROPEAN CENTRAL BANK / EUROSYSTEM

Most of the respondents are willing to support a digital euro once it committed not to discontinue cash *(2021 Digital Euro Public Consultation)*

4 Privacy and Security Risks

There is a risk that governments or malicious actors could track transactions, raising concerns over **surveillance, data misuse, and loss of privacy**

HONG KONG MONETARY AUTHORITY / 香港金融管理局

Given the high monetary value of the CBDC system, it is regarded an attractive target for cyber attackers *(e-HKD: A Policy and Design Perspective Report)*

5 Disintermediation Risk

Users may move deposits from banks into CBDC accounts directly with the central bank, leading to **a reduction in deposit base, lending capacity, and overall profitability**

Bank of England

Banks were concerned that deposit loss leads to falling credit supply and rising lending costs *(2024 Responses to the Digital Pound Consultation Paper)*

Source: Bank of Canada, European Central Bank, Bank of England, Hong Kong Monetary Authority, Quinlan & Associates analysis

ADDITIONAL ADOPTION BARRIERS

KEY TAKEAWAYS

There are several intrinsic adoption barriers that early rCBDC countries are facing, including:

- **Less Mature Regulatory Framework:** There is an absence of regulatory structures to govern usage; and
- **Limited Intermediary Participation:** rCBDC rollout failed to secure early buy-in from key intermediaries, limiting distribution and ecosystem integration; and
- **Outdated Systems:** Current infrastructure in some countries is not yet capable of supporting rCBDC transactions at scale.
- **Incompatible Infrastructure:** Limited internet access in some countries has constrained the functionality and reliability of rCBDCs; and
- **Low Public Understanding:** Insufficient awareness around the value proposition of rCBDCs has resulted in resistance.

In response to weak adoption, some countries (e.g., Nigeria and the Bahamas) have resorted to forced adoption measures, raising questions about whether an rCBDC rollout is justified at all.

Many early rCBDC-issuing countries face various adoption barriers, stemming from a lack of preparatory work on ensuring readiness (in terms of tech. and regulations) and securing early buy-in

Additional Adoption Barriers

Retail CBDC

OUTDATED SYSTEMS

rCBDC was rolled out without fully accounting for the readiness of existing payment infrastructure, with **PoS machines unable to handle CBDC transactions**, resulting in millions of dollars being spent on upgrades

LIMITED INTERMEDIARY PARTICIPATION

In some cases, citizens need to join a bank to use rCBDCs, but the available channels are limited where accounts can **only be opened with a few banks**, constraining consumer access and reducing convenience

INCOMPATIBLE INFRASTRUCTURE

Poor connectivity has undermined user confidence in the reliability of the rCBDC, making daily usage difficult and revealing a mismatch between the rCBDC design and the realities of the local operating environment

LESS MATURE REGULATORY FRAMEWORK

While rCBDC is legally recognised, related **legal and regulatory frameworks are still being refined and improved**, impacting public trust and the scale of adoption

LOW PUBLIC UNDERSTANDING

Public awareness remains limited, with many being **unaware of the distinct purpose or having little knowledge of the key benefits of rCBDCs**, often conflating it with cryptocurrencies

RESULTING TO FORCED ADOPTION MEASURES:

The Central Bank of Nigeria announced the restrictions on cash withdrawals, mandating that remaining banknotes be exchanged within two months, or they will expire

Given the citizens' reluctance to adopt rCBDC, regulators in the Bahamas are forcing commercial banks to get onboard

Source: Wiley Online Library, CATO Institute, COINGEEK, Quinlan & Associates analysis

SECTION 1.2

WHOLESALE CBDC

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GLOBAL wCBDC ADVANCEMENTS

KEY TAKEAWAYS

Central banks around the world are generally further along in the exploration and development of wCBDCs as compared to rCBDCs. This trend is particularly evident in advanced economies, where 17% of central banks are already working on a live wCBDC and 38% are piloting one. Among emerging markets and developing economies, 35% are experimenting with wCBDCs (vs. 27% for rCBDCs).

Overall, we observe a notable divergence in development stages, suggesting a stronger status of wholesale use cases, including the likes of Project mBridge (multiple central banks), Project Ensemble (HKMA, Hong Kong), and Project Acacia (RBA, Australia). wCBDCs are gaining traction as they directly address longstanding inefficiencies in cross-border payments, mitigate settlement risk, and enable capital market innovation through applications such as cross-border trade settlement, FDI, and DvP.

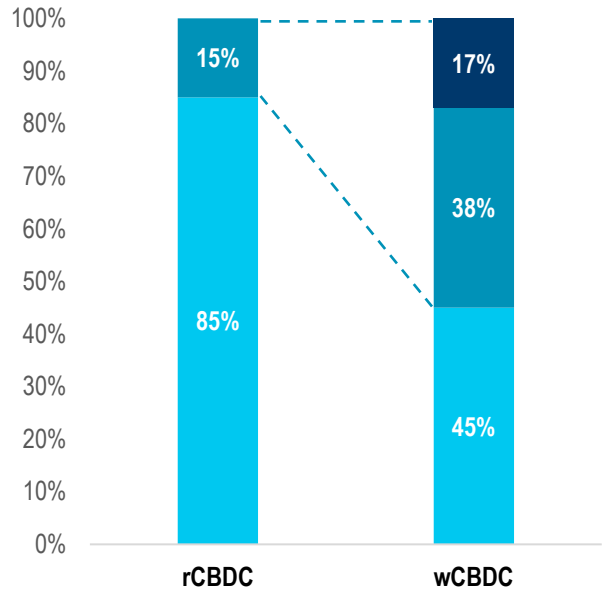
Most countries are generally further along in their exploration and development of wCBDCs as compared to rCBDCs, reflecting strong institutional demand on the wholesale side

Wholesale CBDC Advancements

BIS 2024 Survey

Working on a Live CBDC | Pilot | Research / Experimentation

Advanced Economies



Emerging Markets and Developing Economies

27% Experimenting with rCBDC

35% Experimenting with wCBDC

Use Cases

CROSS-BORDER TRADE SETTLEMENT
Facilitate cheap and atomic large-value settlements between importers and exporters by reducing reliance on correspondent banking networks

FOREIGN DIRECT INVESTMENT ("FDI")
Streamline capital injection by foreign investors into local projects / businesses, reducing FX and settlement risks

TOKENISED ASSET SETTLEMENT
Enable efficient DvP settlement of tokenised securities, bonds, or other assets against CBDC and reduce counterparty risks

Recent Developments

Project mBridge
Project mBridge reached its MVP[1] stage in mid-2024, facilitating real value cross-border transfers, and will be graduating out of the BIS (as announced in October 2024)

Project Ensemble
The Hong Kong Monetary Authority launched a sandbox in August 2024, focused on facilitating seamless interbank settlement of tokenised money through wCBDC

Project Acacia
The Reserve Bank of Australia, together with DFCRC[2], entered Phase 2 in mid-2025, piloting wholesale CBDC transactions across real asset classes

India's Digital Rupee
India's wCBDC is in pilot stage as of 2024, designed to settle secondary market gov't securities transactions to reduce settlement costs and risks without requiring collateral infrastructure

Note: Twenty-eight respondents are central banks from advanced economies (AEs) and 65 are central banks from emerging market and developing economies (EMDEs), [1]Minimum Viable Product, [2]Digital Fiat Currency Research Consortium
Source: BIS, Quinlan & Associates analysis

wCBDC EXPLORATION DRIVERS

KEY TAKEAWAYS

The momentum behind wCBDC development is driven by three main factors:

1. **Clear Value Proposition:** wCBDC pilots are consistently focused on well-defined cross-border use cases, particularly PvP and DvP, where inefficiencies in today's systems are well-known. wCBDCs offer a direct solution to longstanding pain points in large-value cross-border transactions, well beyond the capabilities of traditional correspondent banking; and
2. **Continuity of Practices:** wCBDCs integrate into the wholesale financial system with minimal disruption, unlike rCBDCs that often require changes in end-user behaviour. Institutional users can capture the benefits without the resistance typically associated with behavioural change; and
3. **Risk Reduction:** Concerns about the use of wCBDCs are limited, given the fact that wCBDCs eliminate various risks currently present in cross-border transfers, ultimately helping to lower systemic risk.

Three key drivers continue to boost the development of wholesale CBDCs by central banks, including: (1) clear user proposition, (2) continuity of practices, and (3) risk reduction

Key Drivers
Wholesale CBDC

Clear Value Proposition

Directly improve transaction efficiency in cross-border payments, reducing delays and frictions inherent in today's correspondent banking system

- Given the decline in active corridors within the global correspondent banking network, wCBDCs could offer an alternative payment rail that operates independently of traditional correspondent banking relationships
- wCBDCs enable real-time, around-the-clock settlement, removing the limitations of traditional correspondent banking hours to settle high-value interbank payments
- wCBDCs offer end-to-end payment tracking and transparency, ensuring a visible and auditable settlement process and enhancing oversight and trust in financial operations

Continuity of Practices

wCBDCs directly improve settlement processes for institutions through interoperability and streamlined infrastructure

- The users of wCBDCs are largely institutional (i.e., commercial banks and central banks)
- While rCBDC adoption often demands changes in consumer and merchant behaviour, wCBDCs operate primarily in the financial system's back end and build directly on wholesale settlement processes, where no significant adjustments to the day-to-day operations of commercial and central banks are required
- wCBDCs are typically designed with cross-border interoperability coordinated directly by central banks, reducing the effort needed from commercial banks

Risk Reduction

Strengthen trust by reducing settlement and counterparty risks through atomic PvP[1] and DvP[2] while enhancing liquidity management

- While rCBDCs face significant concerns with respect to privacy, risks of financial exclusion, and concentration of power, wCBDCs intended for institutional use encounter far fewer risks. Apart from questions around the business case and implementation priorities, most perceived concerns are limited
- In fact, wCBDCs are designed to enhance safety via PvP and DvP, eliminating counterparty and settlement risks. Real-time settlement also reduces reliance on intraday credit, enhancing liquidity management for reallocation towards higher-margin activities

[1]Payment Versus Payment, [2]Delivery Versus Payment
Source: RUEDEX, Reuters, CFA Institute, IMF eLibrary, CoinTelegraph, Quinlan & Associates analysis

CLEAR VALUE PROPOSITION

KEY TAKEAWAYS

The root causes of correspondent banking's pain points are largely tied to internal operational challenges, which impede efficiency, transparency, and risk management.

The current demands include the pursuit of greater efficiency and performance (e.g., faster transactions and extended service hours), enhanced transparency, and improved resilience through alternative payment mechanisms.

Aligned with these objectives, wCBDC offer numerous advantages:

- **Time:** Enables real-time settlements and 24/7 operations, significantly reducing settlement delays; and
- **Transparency:** Provides full visibility into transaction timing and payment status; and
- **Resilience:** Offers an alternative network outside of correspondent banking relationships, strengthening operational continuity.

In the wholesale payments sector, particularly regarding cross-border transactions, the key gaps of the current correspondent banking system and the potential benefits of CBDCs are quite evident

Key Pain Points and Corresponding Proposition
Wholesale Payments

1 TIME

Lengthy Settlement Time

1-4 business days
…average time for an international fund transfer by SWIFT[1]

Limited Operating Days & Hours

62 out of 69
…RTGS[2] Systems do not operate 24/7 (CPMI[3] survey)

Real-time Settlement and 24/7 Operations

2 TRANSPARENCY

Unpredictable Settlement Time

>4 timeframes
…for payment to be received by the recipient via RTGS, within 5 mins, 30 mins, 6 hours, or 24 hours

Inability To Track Payment Status

N/A
…information and traceability of payment status under traditional payment systems

End-to-End Payment Tracking & Transparency

3 RESILIENCE

Limited CBR[4] Accessibility

17% decline
…in active corridors in the global correspondent banking network (2011-2022)

Reliance On Intermediary Banks

75%
…of SWIFT transactions involve at least one intermediary bank

Greater Resilience from Less Reliance on CBRs

[1]Society for Worldwide Interbank Financial Telecommunication, [2]Real-Time Gross Settlement, [3]Committee on Payments and Market Infrastructures, [4]Correspondent Banking Relationship
Source: BIS, Bancoli, Finextra, Razorpay, Scotiabank, Financial Stability Board, Statrys, Quinlan & Associates analysis

SECTION 1.3

LESSONS LEARNED

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LESSONS LEARNED

KEY TAKEAWAYS

The underwhelming public adoption of rCBDCs, in particular, provides a number of valuable lessons for central banks looking to successfully launch their own CBDC initiatives:

1. **Identify Existing Pain Points:** Recognise inefficiencies in current payment processes, as well as the maturity of infrastructures and systems, to ensure that CBDC use cases address real needs vs. theoretical benefits; and
2. **Build a Robust Business Case:** Use insights from evaluating pain points under the status quo to select relevant use cases supported by a clear adoption rationale; and
3. **Ensure User-Centric CBDC Design:** Design the CBDC based on evidence gathered from public consultations and stakeholder engagement vs. in isolation; and
4. **Secure Stakeholder Buy-in Pre-Launch:** Implement targeted awareness campaigns paired with well-structured incentive schemes to generate initial uptake and sustained engagement.

Based on observed adoption shortfalls, particularly for rCBDCs, a number of lessons have emerged that can guide central banks on the design and rollout of their own CBDCs

Lessons Learned
Summary

Elaborated on the Next Slide

	OBSERVED SHORTCOMINGS / FAILURES	LESSONS LEARNED
STEP 1 *Identify Existing Pain Points*	x **Poor Understanding of Systems and Pain Points** Some rCBDC systems were not aligned with existing infrastructure (e.g., outdated PoS machines in Jamaica) and user needs (e.g., mature digital payment landscape in China)	✓ Identify inefficiencies in current processes (e.g., domestic payment, government disbursement system) that can form the basis for selecting fit-for-purpose use cases ✓ Evaluate the readiness of technology, connectivity, and operational capacity to ensure the CBDC can be deployed effectively
STEP 2 *Build a Robust Business Case*	x **Weak Business Case** Many tntermediaries, such as banks, have been reluctant to participate due to unclear economic or operational benefits, in addition to risks of potential disintermediation	✓ Select use cases that address identified pain points and deliver tangible benefits for participants, such as by leveraging the programmability features of CBDCs ✓ Develop a clear strategy and business case that motivates banks and payment service providers to paticipate
STEP 3 *Ensure User-Centric CBDC Design*	x **Poorly Designed CBDC Features** Some systems were not accessible to all users, inadvertently driving financial exclusion, with notable usability barriers from a lack of interoperability slowing adoption	✓ Hold public consultations to understand the key priorities and concerns of end users ✓ Thoughtfully design the CBDC with user priorities and concerns in mind (e.g., support offline transactions, embed robust privacy features, etc.)
STEP 4 *Secure Stakeholder Buy-in Pre-Launch*	x **Suboptimal Utilisation of CBDC** There is low organic uptake of CBDC, where most users may be unclear on benefits or usage and incentives appear to be absent or inadequate to drive inorganic growth upfront	✓ Design targeted awareness campaigns that reflect the learning curve of different user groups and assess their effectiveness over time ✓ Complement these efforts with well-structured incentive schemes to offset adoption costs and encourage initial engagement, which can be gradually phased out as familiarity with usage develops

Source: Quinlan & Associates analysis

DESIGN CONSIDERATIONS (1/2)

KEY TAKEAWAYS

CBDC design is multi-dimensional. Central banks must carefully evaluate various design considerations as they shape how the digital money will function, including its impact on the broader economy:

1. **Legal and Regulatory:** Decisions on legal tender status, cross-border rules, and transaction limits determine not only who can access the CBDC but also the degree to which it can replace cash, support cross-border payments, and ensure systemic integrity. Features such as interest-bearing capabilities can also heavily influence incentives for user adoption; and
2. **Technical:** Choices on underlying technology, architecture, privacy, interoperability, and offline functionality affect operational efficiency, trust, and integration with existing financial infrastructure, while enabling advanced capabilities like programmable cross-border payments.

Design choices are critical as they determine not only how CBDCs function but also the capabilities and impact they can unlock within the broader financial ecosystem

Design Considerations

Legal & Regulatory and Technical

	LEGAL & REGULATORY					TECHNICAL				
	LEGAL STATUS	CROSS-BORDER RULES	TRANSACTION LIMIT	HOLDING / BALANCE LIMIT	INTEREST / RENUMERATION	UNDERLYING TECHNOLOGY	OFFLINE FUNCTIONALITY	PRIVACY FEATURES	ARCHITECTURE MODEL	INTEROPERABILITY MECHANISM
Description	Recognition of CBDC as an official currency for acceptance	Rules for resident vs. non-resident wallets and restrictions	Caps on transaction for risk management	Caps on account / wallet balance to prevent risk and misuse	Possible interest that can be earned from CBDC balances	Tech. that governs system operations (e.g., programmability)	Ability to transact without internet / network connectivity	Level of anonymity for transactions vs. reg. traceability	Structural model of issuance, settlement, and management	Ability to work with existing systems and other CBDCs
Possible Options	• Yes (recognised as a legal tender) • No	• Residents only • Residents + non-residents	• Cumulative limit • Per txn[1] limit • No limit	• Monthly limit • Daily limit • No limit	• Non-interest-bearing • Interest-bearing (fixed / variable interest)	• DLT • Non-DLT	• Supported (full / limited for select use cases) • Not supported	• Token-based (fully anonymous i.e., cash-like) • Account-based (pseudonymous / traceable)	• Single-tier retail (i.e., direct) • Two-tier retail (i.e., hybrid / intermediated) • Alternative (i.e., indirect)	• Domestic only • Interoperable with other cross-border payment systems • Interoperable with CBDCs of other jurisdictions
Implications	*Enable acceptance and enforceability as a means of payment*	*Ensure compliance by determining who can transact / hold CBDC*	*Mitigate systemic risks by stopping unauthorised large-value transactions*	*Ensure that no single account holds an excessive fund concentration*	*Can possibly encourage adoption over cash / bank deposits*	*Enable scalability, transparency, and flexibility via programmability)*	*Ensure resilience and usability in low-connectivity areas / emergencies*	*Facilitate user trust and CBDC adoption by balancing anonymity*	*Affect broader oversight and transaction processing responsibilities*	*Support broader adoption via seamless integration with existing systems*

[1]Transaction

Source: BIS, Quinlan & Associates analysis

DESIGN CONSIDERATIONS (2/2)

KEY TAKEAWAYS

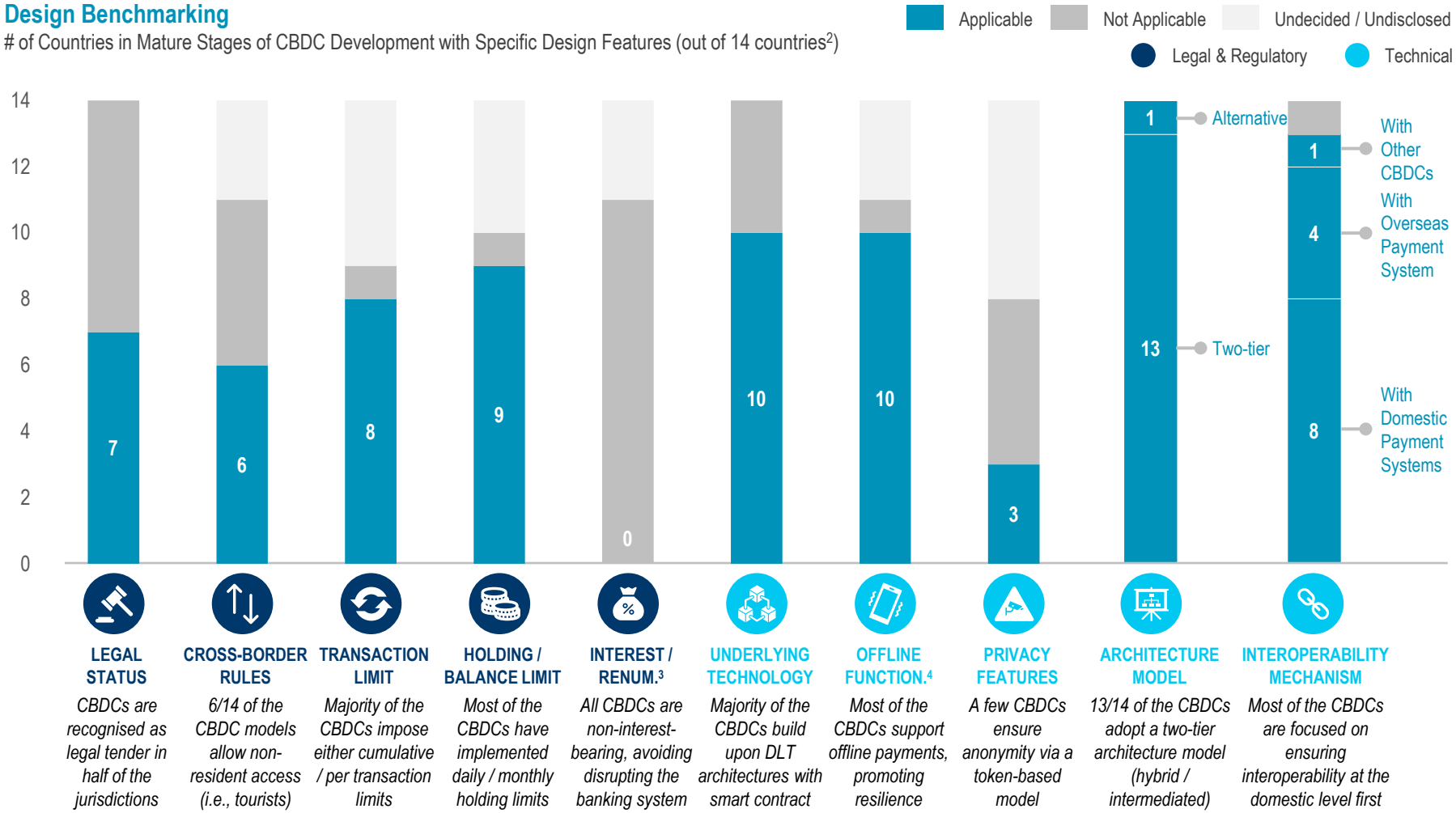
Among 14 countries we evaluated that are actively exploring CBDCs, most have adopted well-defined architectures that balance the following considerations:

1. **Legal and Regulatory:** Approximately half of the CBDCs are recognised as legal tender. Many of them also permit cross-border acceptance for non-residents to expand utility and commonly enforce limits on transaction amounts and holding balances to support AML and compliance objectives. To date, none of the CBDCs provides interest, reflecting their role as digital equivalents of cash rather than instruments for monetary return; and
2. **Technical:** Most CBDCs adopt DLT[1] architectures, support offline transactions, utilise hybrid or intermediate architecture, and collaborate with a broad range of payment systems and other CBDCs, reflecting a technical emphasis on security, accessibility, scalability, and interoperability

Across 14 assessed jurisdictions, the majority of CBDCs lean to a certain architecture model or tech., but some design aspects remain split, highlighting the need for careful consideration by central banks

Design Benchmarking

of Countries in Mature Stages of CBDC Development with Specific Design Features (out of 14 countries[2])



[1]Distributed Ledger Technology, [2]This analysis is based on CBDCs in the Bahamas, Jamaica, Nigeria, China, UAE, Japan, Sweden, Türkiye, UK, India, South Korea, Russia, Thailand and Hong Kong, [3]Remuneration, [4]Functionality

Source: Central Banks' Websites, Quinlan & Associates analysis

CASE STUDY (1/2) – CHINESE E-CNY

KEY TAKEAWAYS

Although the e-CNY has seen only modest uptake to date, several design choices stand out as best practices and offer lessons for other central banks exploring CBDCs:

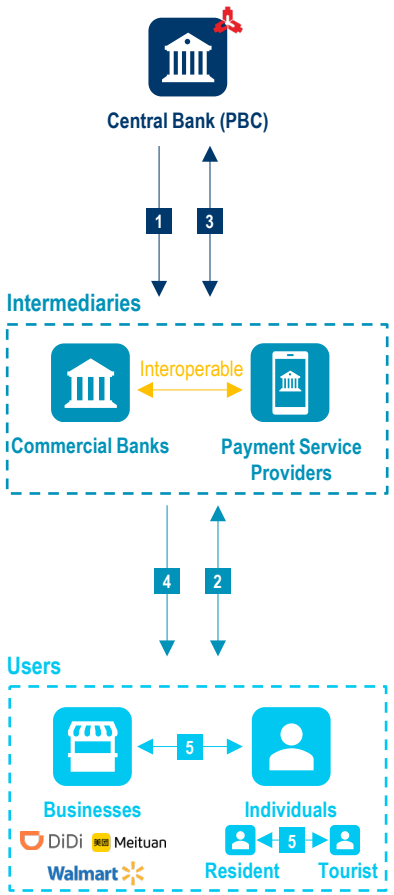
- **Two-tier Distribution Model:** This choice has helped maintain the role of commercial banks and payment providers as consumer-facing entities. In doing so, the PBC alleviates the workload of onboarding, wallet management, and transaction services to the private sector, retaining visibility over transactions; and
- **Non-interest-bearing:** Reinforce e-CNY as a digital equivalent of cash, avoiding unintended monetary policy impacts; and
- **Offline Functionality:** Supporting offline transactions ensures that e-CNY remains usable even in areas with poor connectivity, enhancing accessibility and user confidence.

The digital yuan also integrates with widely used consumer ecosystems, bridging the gap between experimentation and everyday usage.

Among the different models, the most prevalent one adopted by central banks is the intermediated / hybrid model, which is exemplified through China's digital yuan pilot

Intermediated / Hybrid Model

Digital Yuan (e-CNY)



Central Banks | Intermediaries | End Users

1 CBDC ISSUANCE

The People's Bank of China ("PBC") issues the digital yuan through intermediaries, with issuance occurring via reserve account debits / credits and corresponding ledger updates, with each unit of e-CNY representing a direct claim to the PBC

2 USER / WALLET ONBOARDING

End users (both residents and tourists) are onboarded by intermediaries after undergoing proper KYC / AML due diligence (note: the PBC is not responsible for consumer-facing operations), with the e-CNY distributed via wallets

3 TRANSACTION VALIDATION

All e-CNY transactions are validated through centralised infrastructure managed by PBC, which has full visibility of transactions (i.e., traceable and non-anonymous), given the account-based design

4 SETTLEMENT AND CONVERSION

Intermediaries facilitate the instant conversion between e-CNY and bank deposits or cash via ATMs, mobile banking services, or directly within e-wallets. No interest is earned from holding e-CNY

5 P2P AND P2M PAYMENTS

Offline functionality can be used at point-of-sale (for P2M payments) across popular consumer ecosystems (e.g., ride-hailing apps, food delivery apps, major retailers, etc.) and transfer of funds between mobile wallets (for P2P payments) for everyday utility

*PBC adopts a **two-tier distribution model** for the e-CNY, eliminating disintermediation risks*

Source: Payments Canada, SCMP, China Daily, Quinlan & Associates analysis

CASE STUDY (2/2) – PROJECT MBRIDGE

KEY TAKEAWAYS

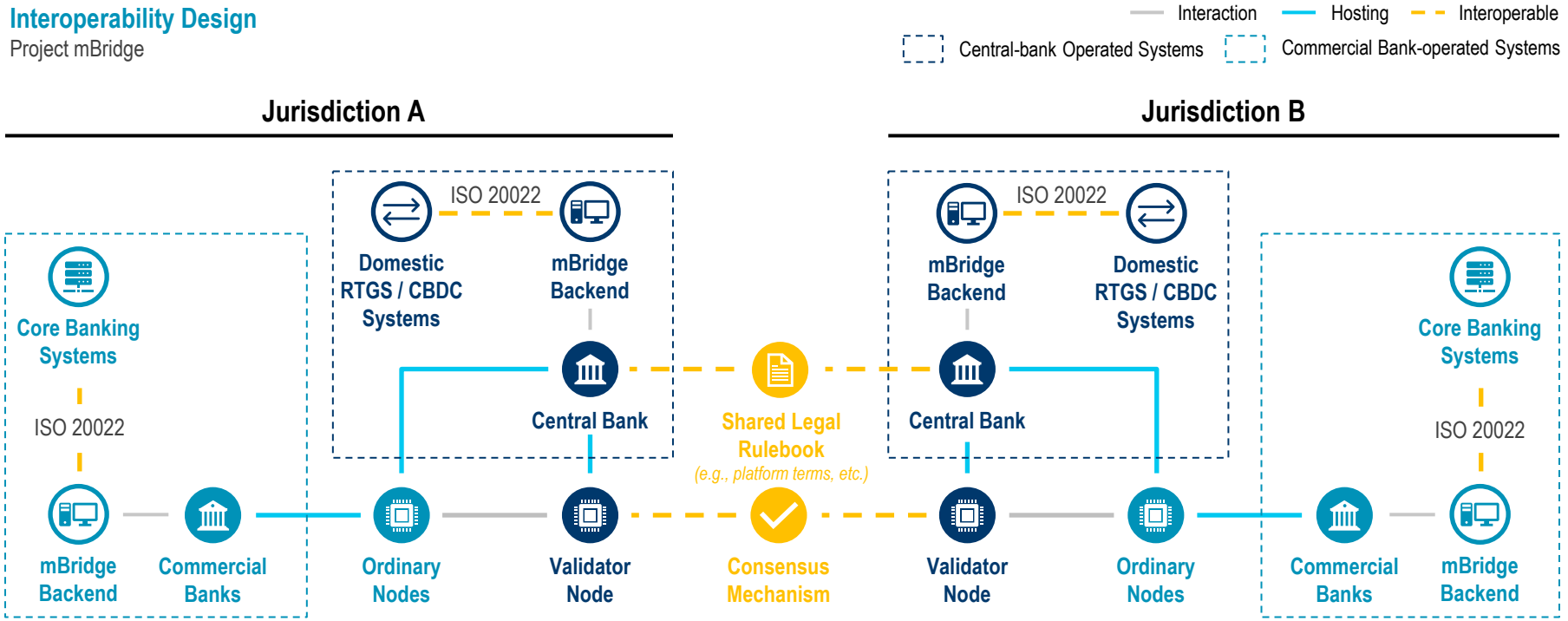
For wCBDC, aside from the typical design considerations, interoperability is top-of-mind. mBridge illustrates how thoughtful design can enable seamless cross-border and cross-system integration:

- **Consensus Mechanism:** Each central bank operates a validator node, ensuring collective participation in the consensus process without reconciliation errors or disputes; and
- **Shared Rulebook:** A common framework of rights, obligations, and compliance standards consisting of four documents that govern participant behaviour and platform usage, ensuring mutual adherence; and
- **API[1] Connectivity:** APIs built on the ISO[2] 20022 standard link the mBridge backend with participants' existing systems, enabling interoperability with commercial banks' core banking systems and central banks' domestic payment infrastructures without costly overhauls.

Together, these mechanisms form a foundation for multi-CBDC interoperability across borders.

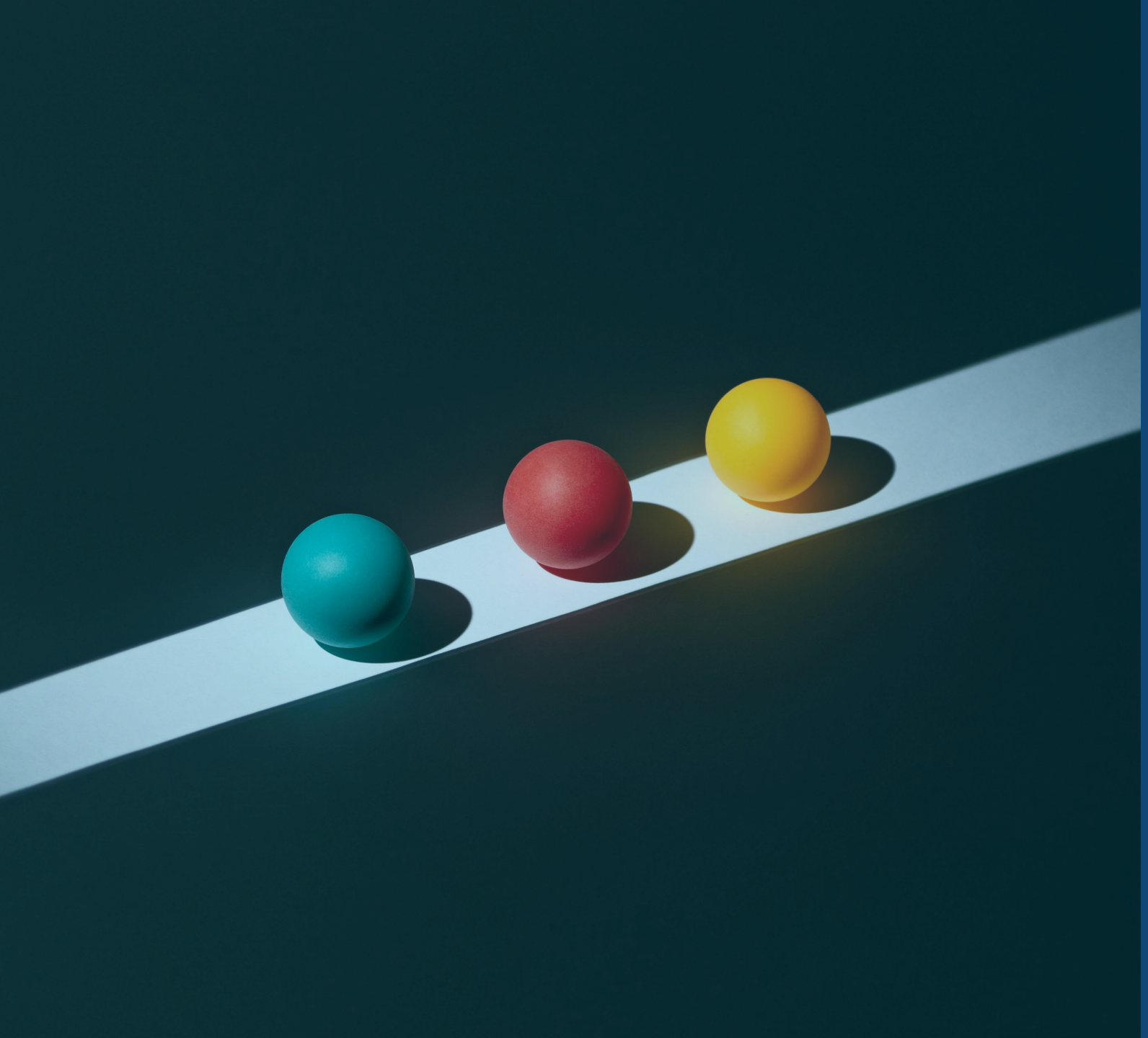
mBridge incorporates interoperability features from both technical and legal perspectives, ensuring integration across jurisdictions as well as between existing banking and payment systems

Interoperability Design
Project mBridge



INTEROPERABILITY BETWEEN CBDC SYSTEMS		INTEROPERABILITY WITH EXISTING SYSTEMS
Consensus Mechanism A distributed mechanism where each central bank operates a validator node to ensure that transactions are validated, settled, and recognised consistently vs. relying on bilateral agreements/separate reconciliation processes	**Shared Legal Rulebook** A set of frameworks that governs access to and usage of the mBridge platform and its functionalities are agreed upon by central bank and commercial bank participants, operating under a unified set of rules vs. applying their own laws	**API Connection** APIs are built on the ISO 20022 standard to ensure a common language across all participants and connect with existing internal payment systems without the need for costly reconfigurations

[1]Application Programming Interface, [2]International Organisation for Standardization
Source: BIS, HKMA, Quinlan & Associates analysis



SECTION 2

ADVANCEMENTS IN OTHER FORMS OF DIGITAL MONEY

QUINLAN &ASSOCIATES

ALTERNATIVE FORMS OF DIGITAL MONEY

KEY TAKEAWAYS

CBDCs represent a unique tool from a policymaker's perspective:

- **Capabilities:** CBDCs support a wide range of use cases, including PvP and DvP with atomic settlement, and can serve as a tool for implementing monetary policy; and
- **Trust:** Unlike privately issued alternatives, CBDCs are neutral instruments free from commercial incentives. Backed by regulatory clarity, they can be tailored to advance broader public objectives (e.g., financial inclusion for the unbanked and underserved)

However, the development of CBDCs should not be looked at in a vacuum. While most CBDCs are still in the experimentation stage, many SCs and TDs have already moved ahead with live deployments strong user adoption, offering advantages in flexibility, interoperability, and ease of issuance due to private sector backing and market responsiveness.

Alternative forms of digital money are rapidly gaining traction, with stablecoins and tokenised deposits seeing much wider live deployments than CBDCs

Digital Currency Comparison

CBDC, SC and TD

Favourability: ✓ High – Medium × Low

	CBDCs	Stablecoins ("SCs")	Tokenised Deposits ("TDs")
Equivalent Asset	Fiat Cash	Fiat Representation	Bank Liabilities / Debt Securities
Capabilities			
Atomic Settlement	✓ (Likely)	✓ (Likely)	- (Dependent)
Interoperability	- (Dependent on public entity collaboration)	✓ (Fast & industry-agnostic via open-source APIs[1])	× (Slow & trend towards walled gardens)
PvP Capability	✓	✓	✓
DvP Capability	✓	✓	- (Dependent on issuer)
Policy Applications	✓ (Direct tool for monetary policy transmission)	× (Risk of currency substitution)	- (Transmission only via banks)
Trust			
1:1 Backing	✓ (Backed by central bank)	- (Likely by commercial banks and NBFIs[2])	× (Unlikely)
Monetary Integrity	✓ (Based on economic stability of central banks itself)	- (Based on issuer credit)	- (Based on qualifying institution credit)
Inclusion	- (May / may not rely on bank account)	- (Depend on digital wallets, on-ramps, internet)	× (Limited to banked populations)
Neutrality	✓ (Neutral public infrastructure)	- (Driven by private incentives)	× (Tied to bank products)
Regulatory Clarity	✓ (Existing regulation applied)	- (Further clarification needed)	- (Further clarification needed)
	Central bank–issued money, which is safe, inclusive, and can act as a policy-enabling anchor	***Digital money issued by the private sector, which is efficient but likely to be driven by private incentives***	***Closed-walled digital money developed by the private sector (i.e., financial institutions), which limits its applicability***

[1]Application Programming Interface, [2]Non-bank Financial Institutions

Source: BISIH and Quinlan & Associates report, "Project Dynamo: CBDCs, Stablecoins, and Deposit Tokens: Wholesale Adoption Exploration and Challenges", Quinlan & Associates analysis

STABLECOIN GROWTH

The market capitalisation of stablecoins has grown markedly over the past five years, predominantly driven by fiat-referenced stablecoins that are mostly denominated in USD

KEY TAKEAWAYS

From 2020-25, the market capitalisation of SCs grew by a compound annual growth rate ("CAGR") of 161%. This upward trajectory has been underpinned by the rapid rise in both monthly active users and transaction volumes within the SC ecosystem.

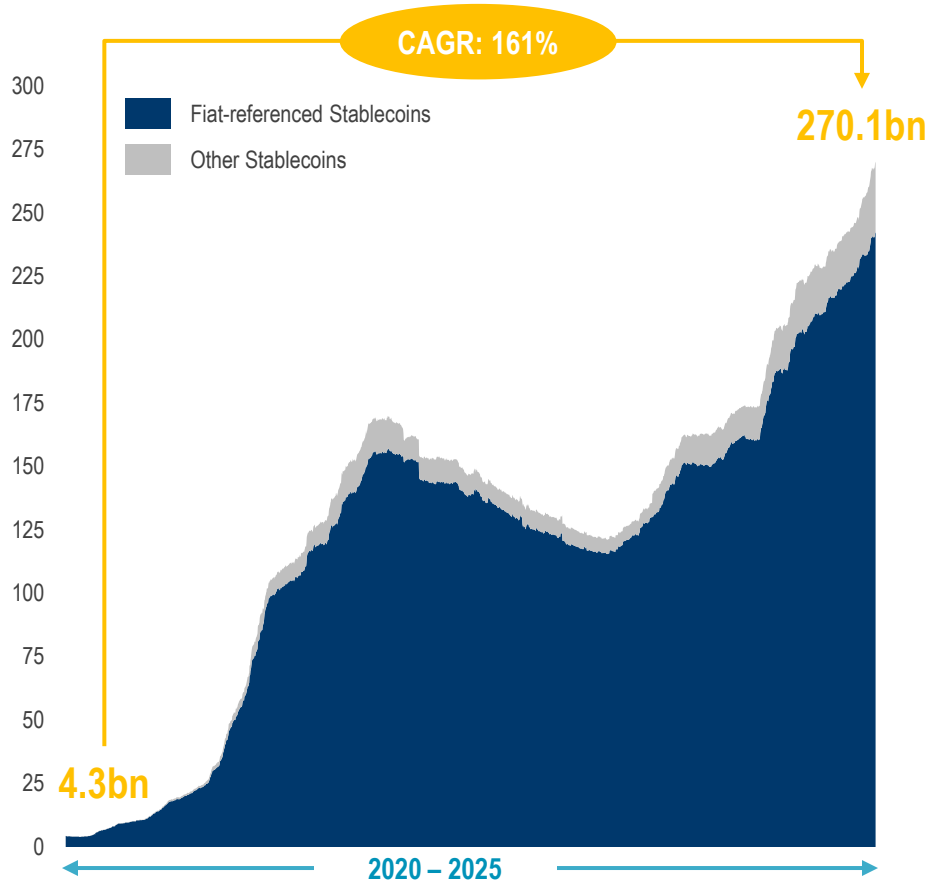
A key driver of this expansion is the dominance of fiat-referenced SCs ("FRS"), which are viewed as safer options relative to other SCs for users seeking greater stability in their digital asset activities. Among the available in the market, the majority are denominated in USD.

Fuelled by positive user and investor sentiment, FRS have emerged as a lucrative and viable financial tool for numerous applications.

Various giant technology companies and financial institutions have explored the development of SCs in recent years, and their reference currencies are primarily pegged to USD and JPY.

Stablecoin Market Capitalisation

USD Billion, January 2020 – August 2025



Fiat-referenced Stablecoin Exploration

By Technology Companies and Financial Institutions, 2023 – 2025

Issuer	Announcement Date	Reference Currency
First Digital	June 2023	USD
PayPal	August 2023	USD
MUFG	November 2023	JPY
Hokkoku Financial Holdings	April 2024	JPY
Sony Bank	April 2024	JPY
BINANCE	November 2024	USD
Societe Generale	June 2025	USD
fiserv.	June 2025	USD
JPYC	August 2025	JPY

Source: rwa.xyz, CoinGeek, Ledger Insights, Mitsubishi UFJ Financial Group, Nikkei, PayPal, Reuters, Fiserv, Nippon, Quinlan & Associates analysis

TOKENISED DEPOSIT GROWTH

KEY TAKEAWAYS

There is growing global momentum among commercial banks in exploring TDs.

According to the 2024 BIS survey, 30% of respondent jurisdictions report that their commercial banks have initiated work on TD projects, reflecting a clear shift toward integrating blockchain technology into traditional financial systems.

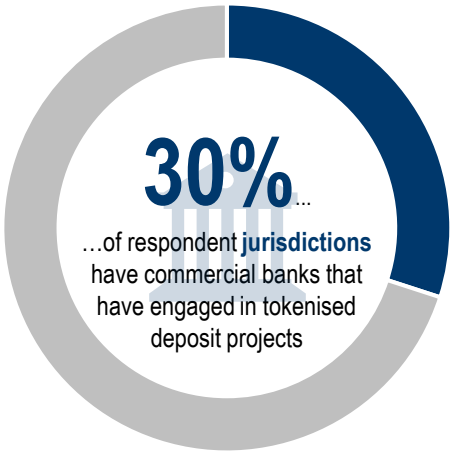
Most commercial banks are currently in the early stages of exploration, with a strong emphasis on research and PoC activities. Some have moved further by running pilot projects or issuing TDs in live environments.

Several major financial institutions, such as Citi, HSBC, and J.P. Morgan, have made public announcements regarding their involvement in TD initiatives.

Commercial banks in multiple jurisdictions have also rolled out tokenised deposits, led by major players such as J.P. Morgan, Citi, and HSBC

Tokenised Deposit

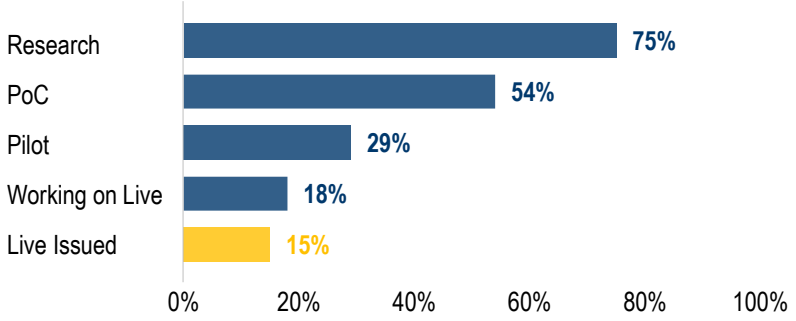
Project Engagement, BIS Survey on CBDCs and Crypto, 2024



equivalent to **28 jurisdictions**

Tokenised Deposit

% of Jurisdictions Engaged in TD Projects[1] (out of 28 jurisdictions), 2024



Tokenised Deposit Exploration

By Technology Companies and Financial Institutions, 2020 – 2025

	Issuer	Announcement Date	Reference Currency
LAUNCHED COMMERCIALLY	kinexys by J.P.Morgan (JPM Coin[2])	October 2020	USD
	citi	October 2024	USD
	Custodia / Vantage Bank	March 2025	USD
	HSBC	May 2025	USD & HKD
EXPERIMENTATION	kinexys by J.P.Morgan (JPMD)	June 2025	USD
	JP Bank ゆうちょ銀行	August 2024	JPY
	OCBC / ANT GROUP	November 2024	Not specified
	VersaBank	August 2025	USD

[1]The percentage that engages with tokenised deposits is based on rough estimations from the BIS Survey on CBDCs and Crypto (2024), with the sum exceeding 100% as jurisdictions can choose more than one option (i.e., in a jurisdiction, some commercial banks may be at the research and PoC stages, or all of the above , [2]Now Kinexys Digital Payments

Source: BIS Survey, Comsure Group, OCBC, Central Banking, HSBC, Fintech Magazine, Quinlan & Associates analysis

KEY SUCCESS FACTORS

KEY TAKEAWAYS

While lessons from live or cancelled CBDC initiatives are valuable, useful insights can also be gained from the success of SCs and TDs:

1. **Design Compelling Incentives:** High-yield structures, staking rewards, and partner-aligned benefits motivate users to adopt SCs and remain active in the ecosystem; and
2. **Cultivate Ecosystem Integration:** Proactive partnerships across Fintechs, payment providers, and platforms enhance SC interoperability, broadening use cases and reinforcing transactional relevance; and
3. **Modernise Existing Systems:** Banks leverage familiar processes and operational frameworks to introduce TDs, lowering adoption barriers for institutional clients; and
4. **Prioritise Risk and Compliance:** Strong governance, robust risk controls, and regulatory alignment reinforce trust, encouraging institutional participants to confidently engage with digital solutions.

Beyond CBDC pilots / trials, central banks should reference stablecoins and tokenised deposits for valuable insights from their real-world adoption, practical utility, and innovation

Select Key Learnings
Stablecoin and Tokenised Deposit Learnings

STABLECOIN LEARNINGS

Design Compelling Incentives
Utilising incentives to drive greater adoption

Stablecoins boost adoption through staking yields and partner-driven rewards, encouraging sustained user engagement

Ethena

Ethena's USDe stablecoin drives adoption with high-yield staking, growing market capitalisation from zero to over USD 12 billion within two year from its initial launch

Cultivate Ecosystem Integration
Creating robust partnerships networks for greater utility

Strategic partnerships expand stablecoin usability across diverse platforms, accelerating adoption and transactional relevance

CIRCLE

USDC partners with 800+ Fintechs, payment providers, and platforms, enhancing interoperability, usability, and accelerating adoption across diverse ecosystems

TOKENISED DEPOSIT LEARNINGS

Modernise Existing Systems
Updating existing system to mitigate adoption friction

Banks modernise traditional processes to deliver tokenised deposit solutions with minimal adoption friction for institutional clients

kinexys by J.P.Morgan

J.P.Morgan's Kinexys leverages the bank's existing deep institutional liquidity and investment banking capabilities to roll out its tokenised deposits, simplifying adoption for clients

Prioritise Risk and Compliance
Advocating adoption through mitigated risk benefits

Trusted risk management frameworks and compliance measures build confidence among institutional participants

HSBC

HSBC markets its existing security and risk management procedures as a main value add for its tokenised deposit payments and cash management services

Source: CoinGecko, Circle Internet Group, J.P. Morgan, HSBC, Quinlan & Associates analysis

SECTION 3

THE FUTURE PICTURE

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ANTICIPATED ROADMAP

KEY TAKEAWAYS

We anticipate the rise of CBDC adoption, broken down into the following key stages:

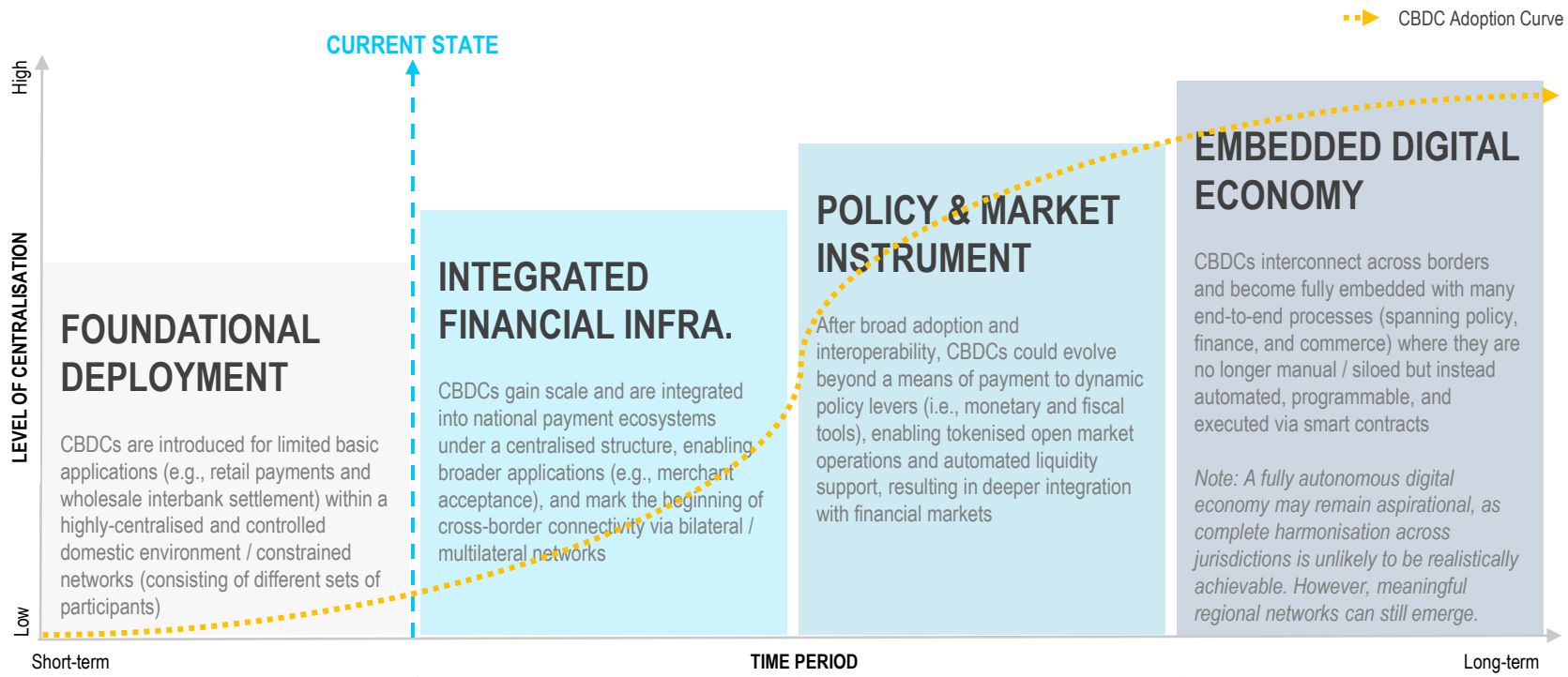
- **Foundational Deployment:** CBDCs are introduced in limited, controlled settings, allowing central banks to test operational resilience and security; and
- **Integrated Financial Infrastructure:** As adoption grows, CBDCs are scaled across national payment systems and connect with other networks via interoperability; and
- **Policy and Market Instrument:** CBDCs move beyond payments to become dynamic tools for monetary and fiscal policy for precise data-driven interventions in the economy; and
- **Embedded Digital Economy:** Economic activity becomes highly automated, programmable, and interoperable.

Throughout this evolution, we anticipate that regulatory frameworks will mature in parallel – from sandbox guidance and initial compliance rules to comprehensive, adaptive laws – while centralisation gradually shifts from fully centralised control to hybrid models balancing oversight with distributed, automated execution.

CBDCs could evolve from limited pilots to interoperable financial systems, transform into dynamic policy tools, and ultimately underpin a programmable digital economy, with regulation maturing alongside

Anticipated Roadmap / Vision

CBDC



Adoption Stage	Largely experimentation / pilot-driven, running in parallel with existing systems	Initial launch stage where CBDC co-exist with cash, deposits, and stablecoins	Wider uptake / early maturity where central banks have proven operational readiness	Widespread adoption that is likely decades away for most economies (end-state vision)
Regulatory Developments	Mostly directed to monitoring compliance with existing laws and establishing sandbox	Begin setting compliance standards and formalising licensing, reporting, etc.	Centered around systemic risk guidelines, given the expansion of CBDC role	Near-full harmonisation of regulations across jurisdictions
Expected Centralisation	Highly centralised	Mostly centralised	Centralised in policy, distributed in execution	Hybrid / distributed

Source: Quinlan & Associates analysis

VISION FOR A DIGITAL MONEY ECOSYSTEM

Alongside TDs and SCs, CBDCs have the potential to operate across all aspects of traditional financial ecosystems, particularly for cross-border applications to address walled-garden limitations

Key Takeaways

When more CBDCs go live and are deployed to live environments, they may serve as a wholesale tool for financial institutions, where wCBDCs can provide a more accessible form of central bank money. Retail applications are particularly relevant for government disbursements and open market operations, while rCBDCs can also complement domestic payments alongside SCs.

Given the low barriers to adoption and versatility across traditional and digital ecosystems, SCs may sustain momentum across many user-centric ecosystems.

As CBDCs and SCs expand into broader, more open ecosystems, the use of TDs (for institutional operations) may gradually diminish or be repurposed.

Digital Money Ecosystem

Anticipated Outlook

CBDCs (Retail and Wholesale)

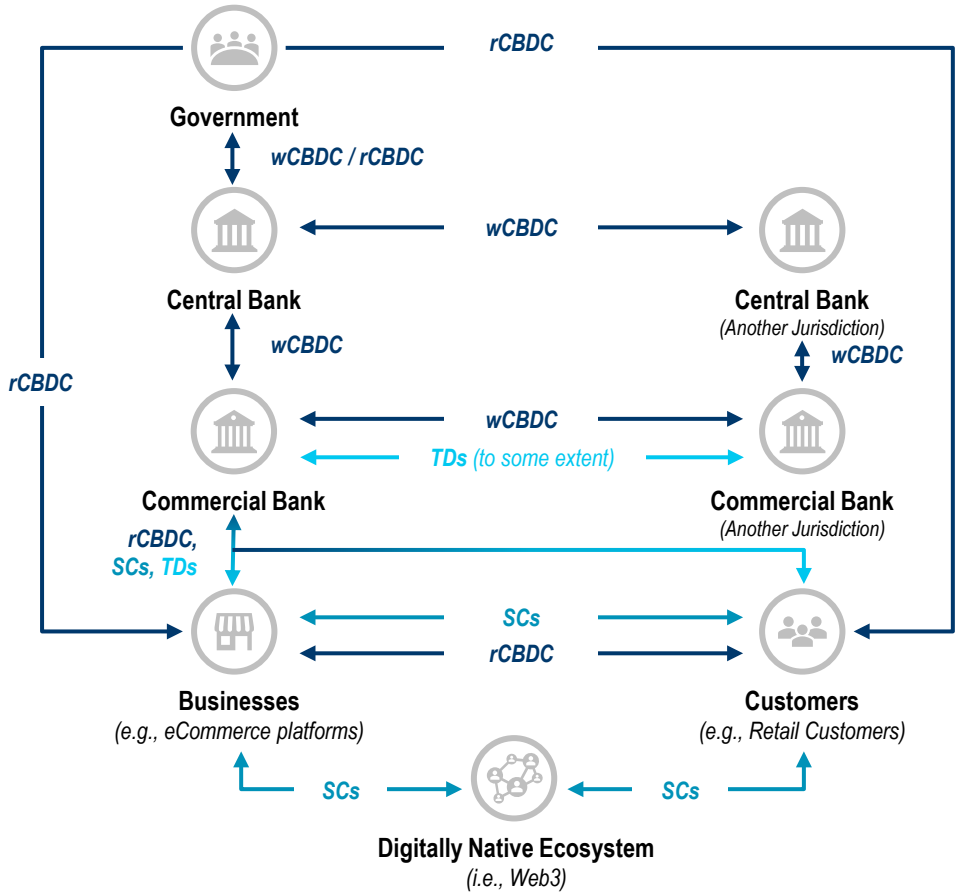
CBDCs have strong wholesale applications, acting as a digital central bank currency for FIs in large-value cross-border payments. rCBDCs could have an intrinsic role in government disbursements and open market operations for monetary policy, while existing alongside SCs for domestic payment needs

SCs

SCs will act as an easily adoptable digital currency settlement rail with applications across digitally native and traditional financial ecosystems

TDs

TDs will act as a settlement rail for intra- and inter-financial institutions due to their current compatibility with the existing deposit ecosystem, but only to a certain extent as most operate within a walled-garden environment



Source: Quinlan & Associates analysis

OUR EXPERIENCE

KEY TAKEAWAYS

As central banks navigate this dynamic landscape, our team has provided end-to-end support across the full lifecycle of digital currency initiatives – from initial market landscape studies and benchmarking to post-launch implementation support.

Our deliverables are designed to be actionable and implementation-ready – from governance models and fee structures to operational playbooks – ensuring central banks can move seamlessly from strategy to execution.

Across all these activities, we bring a global perspective on CBDC and payments innovation while tailoring insights to the specific policy, regulatory, and market context of each jurisdiction. This blend of global benchmarking and local relevance has made us a trusted partner to central banks looking to successfully navigate one of the most significant financial transformations of our time.

We have assisted central banks in shaping their CBDC propositions, designing operating and financial models, and guiding implementation

Our Experience
Quinlan & Associates

Market Landscape Study	Benchmarking Research	Operating Model Formulation	Financial Model Development	Implementation Support
*Conducted a **comprehensive assessment** of the evolving digital money and payments landscape (including CBDCs, TDs, and SCs) and developed **practical reference frameworks** for market participants*	*Performed in-depth benchmarking of a **pioneering multi-CBDC** cross-border platform against other payment networks to inform a **differentiated value proposition and positioning***	*Designed and delivered an **end-to-end operating model** outlining the **initial set up and a 5-year roadmap** for a multi-jurisdiction CBDC platform to ensure scalable operations*	*Combine insights from prior analysis and assessment to formulate a **sustainable fee model** aligned with financial objectives (e.g., cost-recovery goal) based on a **robust financial modelling / projections***	*Provided **implementation support** by drafting key onboarding and operational documents, as well as coordinating across workstream owners to **drive smooth execution of the operational roadmap***
• Use case exploration • Adoption challenges and outlook deep-dive (via interviews with 47 industry participants including issuers, infra. providers, IOs,[1] etc.) • Regulatory analysis across key jurisdictions	• Payment system mapping (e.g., SWIFT, CIPS,[2] Hawalas) • Value proposition benchmarking (e.g., settlement time, operating hours, use cases, maturity, tracking feature, etc.) • Gap analysis & recommendations	• Workshop hosting (with key central bank stakeholders) • Operating model design (see below for the components) • Operating model documentation (under a consolidated handbook)	• Fee benchmarking • Fee model design (e.g., membership fee, transaction fees, etc.) • 5-year financial projections (based on fee model and other assumptions)	• Onboarding pack development (for future participants) • Customised white-label pitch deck creation • Outreach prioritisation / support • Project Management Office ("PMO") support

COVERAGE	ORGANISATION / GOVERNANCE	TECHNOLOGY / INFRASTRUCTURE	ECOSYSTEM DEVELOPMENT	PEOPLE & PROCESSES
OBJECTIVE	Designed the governance model, including the **structure and appointment of the BoD,[3] SteerCo, and committees**, along with their **mandates, voting rights, and decision-making protocols**	**Synthesised the source code contribution process** by clearly defining roles and responsibilities, and outlining future considerations for **functionality, toolsets, and API development**	Established an **outreach and onboarding framework**, detailing processes, responsibilities, participant prioritisation, membership conditions, and a **roadmap of use cases** based on a feasibility study	**Proposed staffing arrangements** based on functional requirements, highlighting **potential full-time equivalent (FTE) hires** with their roles, responsibilities, and desired background for certain positions

[1]International Organisations, [2]Cross-Border Interbank Payment System, [3]Board of Directors
Source: Quinlan & Associates analysis

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