

Insight Report

# Central Bank Digital Currency Policy-Maker Toolkit

Centre for the Fourth Industrial Revolution

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# Foreword



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In recent years, central bank digital currency (CBDC) has risen to prominence as a policy and operational consideration for central banks, ministries of finance and other institutions because of its potential to address both long-standing and new challenges such as financial inclusion and payment-system stability. CBDC is a digitized version of sovereign currency, created and issued by, and a liability of, the country's monetary authority.

CBDC differs from other forms of digital or virtual currencies, including cryptocurrencies such as bitcoin and “stablecoins”, which are not issued by central banks or typically considered legal tender. Notably, CBDC may use centralized or decentralized technology systems, and policy-makers should evaluate trade-offs between technology choices before any CBDC issuance.

Academic and policy research on CBDC has proliferated since 2014, as has technological experimentation. More recently, [numerous central banks](#) have been actively evaluating CBDC, spanning continents and economies both large and small, developed and emerging. The motivations for CBDC vary between countries, as does its relevance and potential for creating value. The “case for CBDC” is unresolved, with research and experiments from central banks and academic researchers indicating different assessments of a CBDC's value after considering costs and risks. Ultimately, countries should assess the value of CBDC on a case-by-case basis, evaluating trade-offs and carefully considering risks and design choices. Given the potentially far-reaching consequences of CBDC, policy-makers must apply the utmost prudence.

While many central bank researchers and policy-makers have developed an interest in CBDC over the past few years, most are not yet subject-matter experts. Many research reports on CBDC provide in-depth information and analysis of issues such as macroeconomic impact, financial stability, market infrastructure and design without providing as much information about social risks, governance or implementation strategies. Coupled with the ever-growing body of CBDC research from all corners of the world and the rapid speed of technological developments that relate to CBDC, researchers and policy-makers stand to benefit from a concise framework that can help inform their exploration.

The World Economic Forum's *CBDC Policy-Maker Toolkit* seeks to address the need for a concise, high-level CBDC decision framework that provides comprehensive and risk-aware information to policy-makers. The document serves as a guide to ensure that any CBDC deployment is cautious and fully considers alternative solutions, risks, deployment and governance strategies, multistakeholder input and other salient factors. Notably, it is intended to serve as a complement to additional research that any policy-maker considering CBDC should conduct.

In the development of this framework, the Forum has taken a global and multisector view, drawing input from its unique [global community](#) of CBDC experts and researchers, and developing an approach that is equally suitable for policy-makers in developed or emerging economies. Furthermore, the toolkit can serve as a springboard to a community of practice and experience exchange within the World Economic Forum network as central banks progress with their CBDC investigation and development.

Prior to crafting the *CBDC Policy-Maker Toolkit*, the Forum convened central bank researchers and policy-makers from more than 45 countries to guide its project work related to central banks, CBDC and distributed ledger technology. It is from this input, as well as extensive discussion with additional experts, that the toolkit draws its motivation and content. Succinctly, this framework helps policy-makers within central banks to confidently evaluate whether CBDC is appropriate for their economy.

The *CBDC Policy-Maker Toolkit* is developed within the Centre for the Fourth Industrial Revolution's [Blockchain and Distributed Ledger Technology Platform](#). It builds upon the platform's March 2019 [white paper](#), which highlights central bank activity with blockchain technology as well as the platform's globally unique, curated [list](#) of more than 60 reports on CBDC research and experiments. Notably, the World Economic Forum does not advocate for or against the implementation of CBDC in any country.

# Executive summary

In recent years, central bank digital currency (CBDC), a new form of digitized sovereign currency, has risen to prominence as a policy and operational consideration for many central banks, ministries of finance and other institutions. The intricacies of implementing CBDC are complex and the implications are wide-reaching. As a result, policy-makers may find themselves in uncharted waters when attempting to evaluate the potential benefits and trade-offs associated with CBDC.

The World Economic Forum's *CBDC Policy-Maker Toolkit* seeks to address the need for a concise CBDC decision guide that provides comprehensive and risk-aware information to policy-makers. This document serves as a possible framework to ensure that any CBDC deployment fully considers the costs as well as the potential benefits, appraising a multitude of risks and evaluating deployment and governance strategies, alternative solutions and other salient factors. Notably, it is not exhaustive, and instead intends to serve as a complement to additional research that any policy-maker considering CBDC should conduct.

The *CBDC Policy-Maker Toolkit* provides high-level guidance and information for:

- Retail, wholesale, cross-border CBDC and alternatives in private money such as “hybrid CBDC”
- Large, small, emerging and developed countries.

This toolkit will walk policy-makers through a CBDC evaluation and design process step-by-step, emphasizing the incorporation of multistakeholder input. The flow chart on page 13 of this document illustrates the steps in this process.

- Section 1: The process begins with background assessment and pre-analysis, including consideration of strategic questions related to legal and institutional challenges, project management, decision-making and stakeholder involvement.
- Sections 2 and 3: The process continues with problem identification and analysis, including identification of the top CBDC objectives and goals. It results in the initial selection of the most appropriate form of CBDC.
- Sections 4 and 5: The context for the digital payments ecosystem is outlined, highlighting relevant issues. The policy-maker is then prepared to evaluate “hybrid CBDC” as a potential alternative to retail CBDC if relevant.
- Sections 6, 7 and 8: The potential benefits and risks are considered, including the operational and cybersecurity risks, cost and accessibility, user data protection and privacy, compliance and macroeconomic and financial impacts.

- Section 9: CBDC design parameters are then assessed in light of identified objectives and risks, including custody and storage, anonymity, account and transaction limits, interest payments, and conversion and redemption rates.
- Section 10: Following design, the process focuses on technology choices and requirements to support the CBDC.
- Section 11: The process continues with an evaluation of governance strategies and requirements, including user engagement, financial management, the establishment of performance criteria and monitoring processes.
- Section 12: The toolkit concludes with an initial implementation strategy, including guidance on experimentation and prototyping, public engagement and collaboration in experimentation and deployment.

As policy-makers navigate this process, they should consider how CBDC may introduce new capabilities that support regulatory goals while also introducing new risks or compliance vulnerabilities. CBDC could potentially be used as a tool to achieve policy objectives such as improved safety and resilience in payments systems; increased efficiency, access and competitiveness of payments systems; better data transmission and reporting to central banks; and financial inclusion. The achievement of these goals with CBDC must be evaluated in the full context of the associated trade-offs and risks that CBDC may entail.

A brief summary of the cost/benefit analysis facilitated by the toolkit follows:

	Key opportunities	Key challenges or alternative solutions
Wholesale CBDC	Could improve efficiency in speed and costs for cross-border interbank payments (potential to bypass correspondent banking systems and challenges related to legacy infrastructure, intermediary operating hours or cut-off times, and other interbank processes).	Considering risks associated with CBDC, central banks should determine how frictions can already be addressed, such as by extending central bank and processor operating hours and establishing clear data messaging standards and governance.
	Could reduce settlement and counterparty risks and enable delivery-versus-payment (DvP) or payment-versus-payment (PvP) in cross-border interbank securities transactions and funds transfers. Programmable nature of wholesale CBDC could also apply to other use cases (e.g. within financial market infrastructure).	Domestic wholesale CBDC may not add value in domestic interbank payments where an efficient system already exists (domestic wholesale CBDC is arguably equivalent to central bank reserves).
Retail CBDC	Potential to provide efficient cross-border retail transactions (reduced cost and speed) for users.	Where an efficient domestic retail payment system exists, domestic retail CBDC may not add value net of risks and downsides.
	Potential to improve financial data transmission and reporting to central banks; improve traceability of payments relative to physical cash (e.g. to reduce illicit activity); reduce costs and frictions associated with cash management.	Requires heavy investment in cybersecurity and system resilience.
	Can serve as a counterweight to market power of private payment service providers, increasing competition in the payments market and providing a stable public option for payment services.	Existing alternatives, most notably regulation of payment service providers, should be considered to assess relative attractiveness of CBDC.
	Can provide access to central bank money in an economy where cash usage or availability is declining (e.g. with the rise of digital payments).	Compared to physical cash, risks from counterfeiting, theft and network failure for digital money entail more catastrophic consequences. If retail CBDC is widely used, a system failure would cause substantial interruptions.
	Can provide safe-haven public option for savings, with lower risk of default than storing savings with commercial banks.	Where a strong deposit insurance system is already in place, retail CBDC would probably not provide added value in terms of offering a safe-haven option for retail savings.
	Can challenge commercial banks' market power over retail deposits, pressuring banks to increase interest rates and offer better financial services to depositors.	Generates substantial financial risks, including: 1) bank disintermediation risk, which could reduce bank profits and lending activity; 2) digital-bank-run risk as depositors may rapidly convert commercial bank deposits to CBDC.
	Can potentially improve monetary policy transmission and effectiveness depending on interest rate policies (research indicates mixed value for monetary policy goals alone).	Necessary to consider existing alternatives such as negative nominal interest rates on reserves or fiscal policy measures such as tax rebates aimed at subsidizing households.
	Potential to support financial inclusion goals.	Financial exclusion could arise if the issuing central bank does not take special care to ensure the CBDC is widely accessible within the country.
Can support continued usage of the domestic currency if <i>de facto</i> dollarization or competition from other currencies, including digital currencies, cryptocurrencies or foreign-country CBDC, emerges.	Retail CBDC accounts of all forms could be a significant target for theft and terrorism. If retail or "hybrid CBDC" is used widely, the monetary authority must design and implement strict user data storage and privacy policies and protections.	

“Hybrid CBDC”	Alternative to CBDC and regulation in addressing payment-system stability and market power risks from widely adopted digital payment providers: e.g. central banks can enforce stronger reserve management policies and oversight.	Outstanding regulatory and policy considerations to be resolved. Does not constitute claim on central bank in case of issuer default.
	Allows central bank to support provision of electronic money with safeguards and protections for user funds.	May have impacts on seigniorage that need to be carefully considered.
	Relative to retail CBDC, could probably be implemented more rapidly and enable central bank to focus on core competencies such as transaction settlement rather than a full suite of retail CBDC components and requirements.	Might not offer significant value relative to two-tiered CBDC system or the current system of payment intermediaries.
DLT-based CBDC (retail or wholesale)	Potential for lower-cost interconnectivity or interoperability for CBDC with retail payment providers and infrastructure.	Implementation of nascent technology infrastructure and associated costs and risks, including lack of widespread technical talent and track record for distributed ledger technology (DLT) systems at scale.
	Potential for lower initial implementation cost and faster development.	Higher security costs and risks from greater system openness (presence of multiple validating nodes increases system’s attack surface and risk of data leaks, depending on privacy of transactions and accounts).
	Depending on implementation, may support benefits such as: 1) greater competition in retail financial services; 2) “smart-contract”-driven wholesale CBDC applications (e.g. “atomic swaps and securities transactions”).	Greater risk of “double-spend” and other network attacks with transaction validation deferred to parties other than the central bank.
	Could offer diversification in payment “rails”, providing efficiency gains or serving as a contingency payment medium.	Potentially slower transaction-verification process and lower scalability, depending on network scale, size and consensus algorithm.



# Understanding central bank digital currency

CBDC is a new form of digitized sovereign currency, generally conceived to be equal to physical cash or reserves held at the central bank. It is central bank money, or a component of the monetary base and a direct liability of the central bank.

Currently, central bank money is composed of physical cash (coins and bills) and reserves held at the central bank by financial institutions with access to the central bank's deposit facility. CBDC would constitute a third form of central bank money.

	Coins and bills (physical cash)	Reserves	CBDC
Retail uses	✓	✗	✓
Wholesale uses	✓	✓	✓
Digital form	✗	✓	✓

## Retail CBDC

Today, the general public holds central bank money in the form of physical cash. For a given country, retail CBDC, which can also be called “general-purpose” CBDC, would constitute the first digitized form of central bank money and liability the general public could own. The public could have accounts of the digitized fiat currency with the central bank, or hold CBDC on mobile devices, prepaid cards or other forms of digital wallets. While the central bank issues and manages retail CBDC, several ecosystem participants, such as commercial banks and payment service providers, may be involved in the system through a two-tiered structure, introduced further below, or by offering interoperable payments and services.

## Wholesale CBDC

Wholesale CBDC could be issued by central banks to commercial banks and potentially other financial institutions for use in interbank payments and securities transactions. These institutions could hold wholesale CBDC accounts with the central bank, akin to the reserve accounts they keep today (it could be argued that wholesale CBDC already exists today in many countries in the form of reserves).

Wholesale CBDC for domestic use may not provide additional interbank payment functionality to an economy that already has a well-functioning commercial banking sector and interbank payment system, such as a real-time gross settlements (RTGS) system. Such banks can already efficiently transact with one another using reserves held at the central bank in the manner they would with CBDC. Wholesale CBDC for use in domestic interbank payments may be most relevant for developing economies that need a more efficient interbank system and prefer an alternative to today's standard systems, such as a traditional RTGS system.

Beyond interbank payments, wholesale CBDC could be applied in various countries to interbank securities transactions or financial market infrastructure applications (domestic or cross-border), discussed at the end of this section.

## Cross-border CBDC (retail or wholesale)

The value that a cross-border CBDC provides depends on the economy's unique payments infrastructure and starting point. Cross-border wholesale CBDC may be valuable across economies to enable more efficient cross-border interbank payments. As foreign banks and financial institutions today are generally unable to hold reserve accounts with the central banks of other countries, they must conduct cross-border payments in a much less efficient manner. Rather than transacting and settling through a common central bank in which both parties hold reserve accounts, they route payments through correspondent and other interbank payment networks, entailing extra time, costs and risks.

Generally, a cross-border form of wholesale CBDC in which foreign institutions might own and transact in CBDC could potentially unlock efficiencies related to more direct cross-border interbank payments. For a given economy, the CBDC would constitute the first form of digitized central bank money that could be held and sent directly overseas, where transactions could be made without the need for today's cross-border interbank payment networks.

Likewise, cross-border retail CBDC could allow retail users to send payments, including remittances, across borders in a manner that reduces the need for intermediaries. Importantly, for this to occur, the central bank must allow foreign entities to hold the CBDC. Accordingly, it may raise complex legal or financial integrity questions.

Where cross-border payments involve a foreign-exchange transaction from a domestic CBDC to another country's CBDC, present-day currency conversion frictions remain. The system requires either that a foreign-exchange market-making intermediary is willing to assume foreign-exchange risk or that the transacting commercial banks hold accounts in foreign CBDC.

## CBDC and the central bank balance sheet

When central banks issue CBDC, they may substitute an existing liability, namely physical cash or commercial bank reserves at the central bank, for the CBDC. In this scheme, the composition of central bank liabilities changes, but the size of the balance sheet generally does not change. Alternatively, the central bank could issue CBDC as a new liability in exchange for bonds or other assets, increasing the total size of the balance sheet (i.e. both assets and liabilities increase).



If demand for CBDC is high and commercial bank customers wish to redeem their deposits for CBDC, this might have disruptive consequences on the banking sector, with potential impacts on financial stability. The substitution of deposits for CBDC might also have dampening effects on the money multiplier process, requiring the central bank to grow its balance sheet in order to offset the change and guarantee a sufficient supply of liquidity to the economy. In this case, the central bank may want to determine policies that ensure a controlled roll-out of CBDC in order to prevent such sudden disruptions.

## Account-based CBDC

An account-based CBDC is said to be held directly or indirectly in accounts at the central bank. Account-based retail CBDC could be considered a substitute for commercial bank deposits. It exists as a [claim](#) on the central bank by a known or pseudonymous owner.

### Considerations:

- Under this approach, the central bank may need to open and manage a large number of accounts and conduct related regulatory compliance and customer-service functions, where applicable. As these functions have not traditionally been performed by central banks, particularly in the retail context, they may entail extra operational costs. A two-tiered structure, described below, could help address this challenge.
- Account-based retail CBDC may raise commercial bank disintermediation risks and corresponding financial stability concerns.

## Token-based CBDC

[Token-based](#) retail or wholesale CBDC is said to be held by the owner in digital wallets of various kinds and, like physical cash, represents a “token” or object of stored value that is digital fiat money and that can be directly transacted by owners who are either known or pseudonymous. Because token-based CBDC centres on the token object rather than the holder’s identity (particularly related to [transaction validation](#)), it can arguably afford greater anonymity and fewer user-identity requirements than account-based CBDC.

### Considerations:

- Token-based retail CBDC may be preferred if the central bank seeks to design a CBDC that is widely accessible like cash, potentially allowing foreign citizens and entities of various kinds to use it and not requiring user identification.
- If user identities are not required, and the CBDC can be sent to anyone with a suitable digital wallet, then a wider audience could employ the digitized sovereign currency. This could potentially support policy goals related to widening access to central bank money and an efficient means of retail payments. Anonymity and transaction privacy could also be stronger.

- However, a universally accessible CBDC without identity requirements would increase the risk that the CBDC could be used for illicit activity and also conflict with most know-your-customer (KYC), anti-money laundering (AML) and countering the financing of terrorism (CFT) requirements. As a result, token-based CBDC for wallet holders who are non-identified parties may be more suitable if restricted to small-value transactions.
- Without strict user-identity requirements, it might also be more difficult to restrict usage to certain types of participants or within state borders with token-based CBDC. All else being equal, accessibility is both easier to scale and more difficult to control in the token-based CBDC concept.

Conceptions and implications related to token or account-based CBDC vary across institutions and research, potentially calling into question the categorization and its value for CBDC investigation.

## Two-tiered CBDC

A two-tiered CBDC system could enable customers to hold CBDC with commercial banks or other third parties that serve as the user-facing intermediary, managing accounts, customer service, compliance and other requirements. Two-tiered models could alleviate challenges related to customer account management and compliance requirements and mitigate commercial bank disintermediation. CBDC remains a claim on the central bank by users, despite the involvement of intermediaries.

Conceptions of two-tiered structures vary as few have been fully designed or developed. For instance, CBDC held in a two-tiered structure at a commercial bank might need full 100%-reserve backing in order to remain a liability of the central bank and guaranteed in the event of commercial bank insolvency. Based on interests and needs, policy-makers can evaluate whether a potential two-tiered structure meets their goals and objectives.

## What is innovative about CBDC?

Account-based CBDC, in all forms, is feasible today with existing technologies. For any central bank considering CBDC, the question should be asked as to why an account-based form of CBDC has not yet been established. Put differently, why have central bank accounts for retail customers (retail CBDC), or for foreign financial institutions (cross-border wholesale CBDC), not yet been developed?

	Domestic	Cross-border
Retail	Non-financial users could hold accounts of digitized central bank money	Foreign non-financial users could hold accounts of digitized central bank money
Wholesale	Akin to electronic central bank reserves	Foreign financial institutions could hold accounts of digitized central bank money

## Transaction verification

Transaction verification for any digital money is crucial to its operation. For physical cash, anti-counterfeiting measures ensure cash is genuine. Digital money is also subject to counterfeiting risk: A vulnerability in the system could allow digitized money to be created out of thin air. Digital money also suffers the added complication of “double-spending” risk, an instance in which the same digital money is spent multiple times illegitimately. The purpose of transaction verification for CBDC is to verify there is no “double-spending” or other electronic manipulation of the digital currency and transactions.

Within the cryptocurrency ecosystem, the Bitcoin network was the first to solve the “double-spend” problem of digitized money in the context of decentralized transaction verification, in which transactions are not validated by a trusted authority but rather a network of computer nodes. Two innovations were combined to make double-spend economically unviable: a linear trail of transaction history for all bitcoins (or fractions of bitcoins) to ensure they have not been double-spent; and a computational puzzle (the “proof of work” consensus algorithm), which raises costs to the types of network attacks (e.g. 51% attack) that could enable double-spending.

Transaction validation for CBDC can occur with a single party such as the central bank validating transactions, or in a decentralized manner with multiple parties validating transactions using blockchain and distributed ledger technology (DLT). If DLT is employed for transaction verification, then the validating parties (“nodes”) in the system reach agreement (“consensus”) on transaction validity in a decentralized manner according to a specific consensus algorithm. This process could occur as it does with bitcoin, with an unconstrained network of nodes. In this case, scalability protocols that can support higher transaction performance would probably be required. These could include second-layer systems that improve scalability for a given blockchain network, or potentially new blockchain networks whose designs and consensus mechanisms enable faster transaction processing.

Most likely, DLT-based CBDC would operate best within a closed “permissioned” network of pre-identified validating parties that use simpler and resource-efficient consensus algorithms such as “proof of authority”. The central bank could remain a validating node if desired, and regulators or other institutions could participate as additional validating nodes or observer nodes where they could have validating or view privileges.

## What role could DLT serve in CBDC?

One important determinant of whether DLT should be used is whether the central bank or a centralized transaction verification authority is best positioned to verify and settle payments made in the system, or whether this should be delegated to a distributed network. DLT enables decentralized transaction validation for CBDC when a centralized validation system within the central bank is not preferred.

If DLT were to be used in a CBDC system, the central bank would fully control the issuance of CBDC, as it does with a centralized system. However, it could delegate transaction approval to a more decentralized network, most likely consisting of regulated financial institutions. Transaction approval could follow a pre-specified consensus process determined by the central bank, which could include privileges for the central bank such as transaction “veto” powers or visibility. It is also possible to develop a DLT system in which the central bank remains the only validating node yet it benefits from other advantages related to DLT. In the National Bank of Cambodia’s Bakong National Payment System, the world’s first full-scale deployment of a quasi-form of CBDC that launched in July 2019, the central bank performs all transaction validation, although transactions occur within the [Hyperledger Iroha](#) DLT framework. This effort is summarized in the [Section 12 Appendix](#).

If policy-makers are considering CBDC, they should carefully evaluate the trade-offs specific to their economy to determine whether a centralized or decentralized verification process best satisfies their interests. The opportunities and challenges of a DLT-based CBDC system include the following:

Opportunities with DLT-based CBDC	Challenges with DLT-based CBDC
<ul style="list-style-type: none"> <li>– Potential to bypass central bank or other central authority to validate transactions. (This could alleviate operational or technical frictions where they exist, such as central bank operating-hour limitations, and where they are difficult to solve directly.)</li> <li>– Potential for lower implementation cost and faster deployment, as DLT payment networks can be set up quickly with support from third parties acting as nodes.</li> <li>– Potential for lower-cost interconnectivity for CBDC with retail payment providers and infrastructure, if DLT network enables easier and more open API connectivity. This capability may support competition in retail financial services.</li> </ul>	<ul style="list-style-type: none"> <li>– Potential for high security costs and risks from greater system openness (presence of multiple validating nodes increases the system’s attack surface and risk of data leaks, depending on privacy of transactions and accounts).</li> <li>– Greater potential risk of “double-spend” and other network attacks with transaction validation deferred to parties other than the central bank.</li> <li>– Implementation of nascent technology infrastructure and associated costs and risks, including lack of widespread technical talent and track record for DLT systems at scale. Linking distinct institutions and parties across complex financial systems through distributed networks probably creates new cybersecurity challenges.</li> <li>– Potential for slower transaction verification processes and lower scalability, depending on network scale, size and consensus algorithm.</li> </ul>

Some argue that DLT-based CBDC transaction verification could support greater transparency in CBDC payment processes or better preserve the anonymity of senders and receivers. However, both a DLT-based and traditional central bank-managed system could make transaction records publicly visible in real time if needed or support pseudonymous accounts or obfuscated transaction information. All else being equal, the narrower set of validators within a central banking system, potentially only the central bank, preserves confidentiality to a greater degree.

It might be argued that a DLT-based system could provide greater resilience and continuous functionality from the participation of multiple nodes in the transaction validation process. However, DLT systems are largely untested at scale and involve new or different security vulnerabilities and complexities. Compared with time-tested software systems, they may not increase overall system resilience.

### Wholesale CBDC in cross-border interbank securities transactions and funds transfers

The programmable nature of wholesale CBDC can support interbank securities and derivatives transactions, including cross-border “atomic” swap transactions. Collaborative research published in 2019 by the [Monetary Authority of Singapore and the Bank of Canada](#) and by the [European Central Bank and the Bank of Japan](#) investigates DLT for enabling rapid and complete cross-border interbank securities transactions using a blockchain-based wholesale CBDC. Using conditional programming and cryptographic hash functions in a process called “hash time-locked contracts”, the full and final payment and settlement for a trade occurs at the same time the asset is fully (or “atomically”) delivered to the buyer. Both the asset and currency are located on the distributed ledger and they are traded simultaneously (this capability supports delivery-versus-payment goals). The nature of the “atomic” transaction is such that either both delivery and payment happen simultaneously or neither occurs. The result is greater operational efficiency and reduced settlement and counterparty risk.

While both research projects mentioned in the previous paragraph employ blockchain technology, the functionality for “atomic” swap transactions does not depend on DLT but rather on conditional programming and general-purpose hash functions. However, using “smart contracts” with blockchain technology could enable certain benefits such as automated and transparent escrow accounts for participants that reduce the need for intermediaries such as clearing houses or custodians to guarantee and deliver funds in exchange for assets. Depending on implementation, this capability may constitute another benefit of employing DLT.

Wholesale CBDC could also be applied to use cases and applications in cross-border fund transfers and financial market infrastructure, where it could provide benefits such as improved efficiencies through reduced settlement layers, better foreign exchange liquidity management and streamlined regulatory compliance. For instance, the Bank of Thailand and Hong Kong Monetary Authority’s [Project LionRock-Inthanon](#) experiments with creating a DLT-based corridor network that allows banks in two jurisdictions to conduct instantaneous peer-to-peer transactions using wholesale CBDC across borders. Using smart contracts, cross-border fund transfers can be embedded with foreign-exchange transactions so that on-demand foreign-exchange liquidity management can be achieved.

# Toolkit

The World Economic Forum Centre for the Fourth Industrial Revolution's *CBDC Policy-Maker Toolkit* aims to be a user-friendly and risk-aware decision-making toolkit for central bank and other policy-makers from anywhere in the world considering designing and deploying a central bank digital currency. It aims to present the most salient information related to CBDC rather than to serve as an exhaustive resource.

The toolkit is meant to serve as a fact-based and neutral guide. The Forum does not recommend or discourage the issuance of CBDC, nor does it endorse a best-suited technology or platform for implementation. CBDC analysis must be conducted on a country-by-country basis with consideration of the best solutions for the country's distinct needs. Moreover, CBDC is a complex research subject with potential large-scale implications for any economy. Policy-makers should use this toolkit to complement extensive independent research on CBDC.

The *CBDC Policy-Maker Toolkit* provides high-level guidance and information for:

- Retail, wholesale, cross-border CBDC and alternatives in private money such as “hybrid CBDC”
- Large, small, emerging and developed countries.

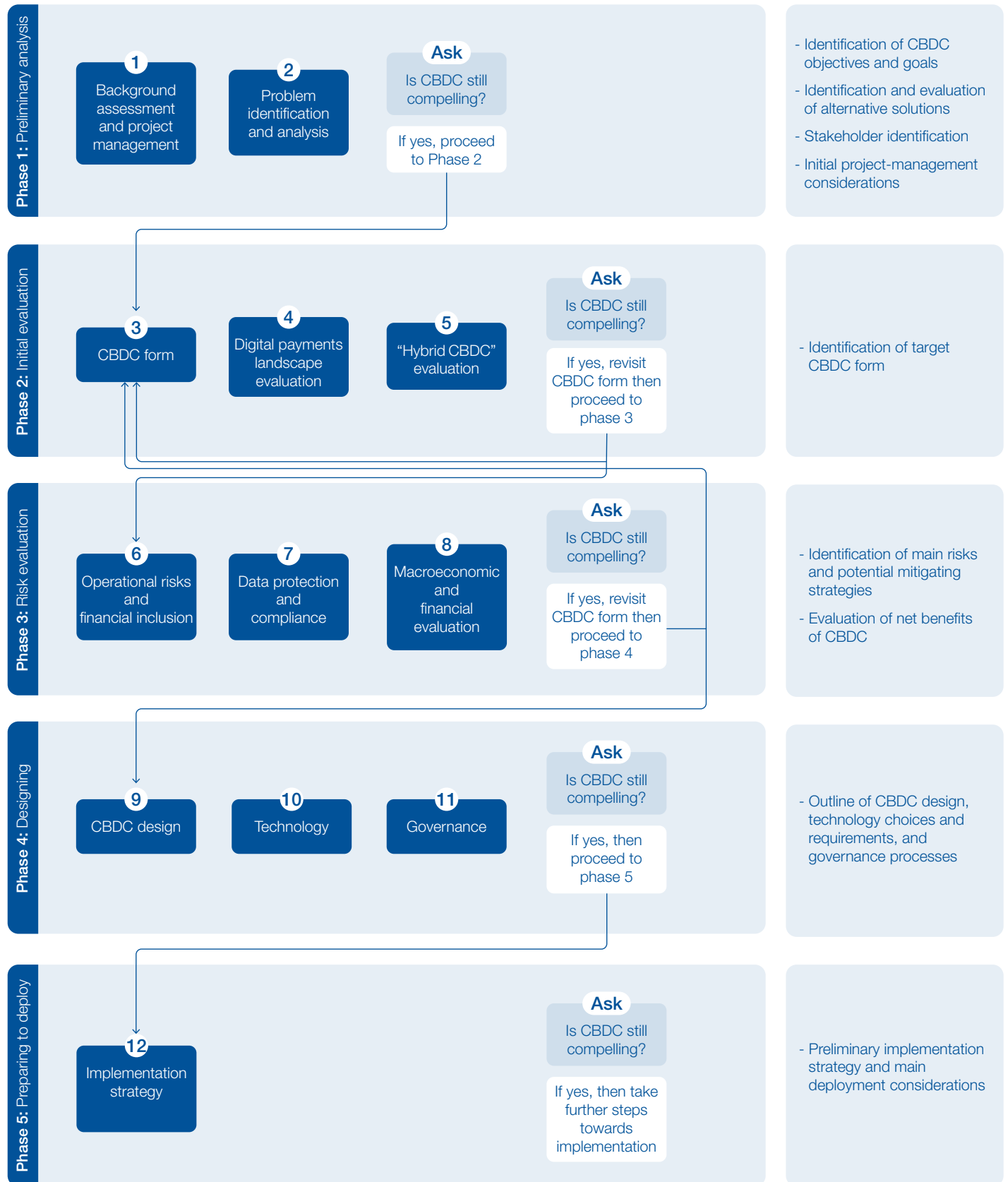
The toolkit comprises several components:

- Overview of the CBDC concept
- Linear flowchart of an example CBDC evaluation process
- Descriptions and guidance for each stage of the process
- Worksheets and informational guides (appendices) that accompany and correspond to each section. These documents serve as process checks and references.

Policy-makers should review this toolkit in a linear manner, along with the accompanying worksheets, and they should reference the appendices as needed. The toolkit should be reviewed in full or until CBDC is determined to no longer be a relevant pursuit. While the toolkit is not intended to be modular, policy-makers may also review sections in isolation.

Please note that any references to CBDC are relevant for both wholesale and retail CBDC unless otherwise noted. In addition, they are agnostic as to the technology platform being used – centralized or decentralized technologies – unless otherwise indicated.

The graphic below illustrates the CBDC decision flow chart:



The flowchart above serves as an example of a CBDC evaluation and design process. Each country's approach to evaluating CBDC will be unique and should follow its needs and interests. For instance, CBDC evaluation may take a more dynamic or cyclical form, where issues are continually re-evaluated.

## Phase 1 – Preliminary analysis

### 1. Background assessment and project management

Policy-makers should first assess their institutional priorities, constraints and in-house knowledge and experience with CBDC. This provides context and motivation for any CBDC investigation.

The policy-maker could begin by considering the following high-level, strategic questions:

- What are the institution’s current high priorities and strategic goals related to the retail or wholesale payments system or to CBDC specifically?
- What are the institution’s constraints that could influence CBDC research and development?
- Is there an existing research agenda related to CBDC?
- What is the in-house knowledge, experience and expertise related to CBDC?
- Was CBDC in any form explored or considered in the past?
- What are the current positive or negative beliefs related to CBDC?
- Is there demand for and interest in CBDC among other stakeholders in the economy?

Next, policy-makers could evaluate the following imperative questions related to legal constraints, multistakeholder input and the CBDC project management process:

#### Legal and institutional evaluation

- What is the role of the state and central bank in retail payments?
- Is CBDC issuance within the central bank’s mandate, considering payment-system operations and oversight, financial institution supervision and regulation, monetary policy and other mandates? Is it legally permissible? If relevant, are changes possible that would enable CBDC?
- Which requirements with respect to laws and legal supervision exist that constrain or inform CBDC, including AML/CFT compliance?
- Which potential legal roadblocks or regulatory constraints exist?
- Are existing legal and regulatory requirements compatible with the issuance of CBDCs or will different standards need to be developed prior to issuance?

#### Multistakeholder input

Expertise and input from multiple perspectives including the financial sector and end users could, if properly implemented, strengthen CBDC design and deployment.

- Which parties in the public or private sector are required to provide input or consultation regarding a potential CBDC or changes in the payments system?
- From which institutions or parties would it be beneficial to solicit input?
- Which additional stakeholders should be represented and involved in decision-making?
- How will coordination between various stakeholders be managed?

#### Project initiation, management and decision-making

The process for making decisions for CBDC design and implementation should be determined early in the CBDC project-management life cycle. Questions and considerations include:

- How will the working group managing and designing the CBDC process be identified? Could representatives from across departments and areas of expertise form the working group? How will coordination about the project be managed within the institution?
- What is the strategy and set of rules governing decision-making related to the CBDC?
- How much autonomy does the central bank have in the design, development and deployment of the CBDC? Engagement with parliament, the ministry of finance or other institutions may be desirable.

 See the Appendix to Section 1 for relevant research about CBDC for this section.

 Answer these questions in the Worksheet for Section 1.



## 2. Problem identification and analysis

In this stage, the policy-maker identifies the various challenges that a CBDC could potentially help address. He or she also conducts a preliminary analysis of the feasibility and suitability of CBDC to address these problems relative to high-potential alternative solutions. While the answers to these questions may change as the policy-maker proceeds through the toolkit, they are an essential first step to critically review CBDC and understand its potential role in the economy.

To begin, list the major country-specific geographic, political, economic and technological conditions that could affect the usefulness or desirability of CBDC:

### Examples:

- **Geographic:** A country with many small islands or severe weather seasons may have cash distribution, availability and security challenges and benefit from CBDC.
- **Political:** A democratic country may want multistakeholder involvement in decisions about issuing retail CBDC and cash policies.
- **Economic:** A dollarized economy may benefit from CBDC if it has a shortage of small currency; a country with a fragmented payments system or low financial inclusion could benefit from a retail CBDC that harmonizes existing payment systems and connects citizens to bank accounts.
- **Technological:** A country with high internet connectivity and mobile phone penetration could have greater adoption of retail CBDC. A country with rapidly declining cash usage could benefit from the availability of a retail CBDC as a public option for digital payments.

Start by identifying the problems that CBDC could address, examining how viable and feasible CBDC is in addressing these problems and the viability of alternative solutions.

- What are the most important problems or challenges that a CBDC could potentially address, considering both retail and wholesale payments?
- How valuable or important is it to address these problems?
- How feasible and suitable is CBDC to solve these specific problems?
- What is the highest-potential corresponding alternative solution that could also address these problems?

After the preliminary analysis above, could CBDC potentially effectively address high-priority problems or challenges? Which ones?



See the Appendix to Section 2 for information that can inform answers to the questions.



Answer the questions for this section in the Worksheet for Section 2.



If there are no relevant objectives or high-potential CBDC applications identified, consider pausing evaluation of CBDC.

## Phase 2 – Initial evaluation

### 3. CBDC form

If the Phase 1 analysis indicates that CBDC may be a good fit for addressing challenges, then the policy-maker should preliminarily identify the CBDC form that appears to be the best fit for the identified needs. The CBDC form will be revisited at multiple points in the toolkit, and selections should be updated based on new decisions and information.

Forms of CBDC:

- Retail CBDC
  - Domestic
  - Cross-border
- Wholesale CBDC
  - Domestic
  - Cross-border
- “Hybrid CBDC” (introduced in Section 5).

Which CBDC forms are relevant to pursue, and why? How do these forms potentially meet policy objectives?



See the Appendix to Section 3 for important research references related to CBDC forms.



Fill in the selection(s) on which CBDC form(s) it is most relevant to pursue, and why, in the Worksheet for Section 3.

## 4. Digital payments ecosystem and landscape evaluation

In this section, the policy-maker considers whether and how the domestic and international digital currency and payments ecosystems influence decisions around CBDC.

Most relevant for retail CBDC
<ul style="list-style-type: none"> <li>– <b>Domestic or overseas payment service providers (PSPs)</b></li> </ul>
<ul style="list-style-type: none"> <li>– Examples: Alipay and WeChat in China, Swish in Sweden, Paytm in India, M-Pesa in Kenya, Venmo in the US</li> </ul>
<ul style="list-style-type: none"> <li>– <b>Fast retail payment systems</b></li> </ul>
<ul style="list-style-type: none"> <li>– Examples: BiR in Sweden, FPS in the UK, FAST in Singapore, CD/ATM system in South Korea, IBPS in China, IMPS in India, TIPS and RT1 in Europe, FedNow Service in the US (under development)</li> </ul>
<ul style="list-style-type: none"> <li>– <b>Globally available cryptocurrencies</b></li> </ul>
<ul style="list-style-type: none"> <li>– Examples: bitcoin (BTC), ether (ETH)</li> </ul>
<ul style="list-style-type: none"> <li>– <b>Stablecoins</b></li> </ul>
<ul style="list-style-type: none"> <li>– Examples: CENTRE Foundation's USDC, Tether, Libra token, MakerDAO's Dai, Paxos Standard, Gemini Dollar</li> </ul>
Most relevant for wholesale CBDC
<ul style="list-style-type: none"> <li>– <b>Innovations in existing/legacy market infrastructures</b></li> </ul>
<ul style="list-style-type: none"> <li>– Examples: SWIFT gpi initiative</li> </ul>
<ul style="list-style-type: none"> <li>– <b>Crypto-assets designed for inter- or intrabank payments and settlements</b></li> </ul>
<ul style="list-style-type: none"> <li>– Examples: JPM Coin, XRP</li> </ul>
<ul style="list-style-type: none"> <li>– <b>Collaboratively developed DLT-driven interbank payment systems</b></li> </ul>
<ul style="list-style-type: none"> <li>– Example: Utility Settlement Coin (USC)</li> </ul>
Relevant for wholesale or retail CBDC
<ul style="list-style-type: none"> <li>– <b>Foreign-country CBDC</b></li> </ul>
<ul style="list-style-type: none"> <li>– Examples: China (DC/EP, under development) and others</li> </ul>

Referring to the list above and other relevant ecosystem participants, consider the following questions:

- Which important existing and future forces, trends, market participants and services is it necessary to monitor and consider? How could these evolve over time?
  - **Example:** Are there any prominent PSPs or potential market entrants in the economy? What is their current role and how could it evolve?
- How would issuing a CBDC influence and be influenced by these market participants, services and forces?
  - **Example:** Which risks could arise in the economy from the CBDC interacting with any of these platforms? Can policies or regulations be designed to mitigate these risks? Could a CBDC inhibit private-sector innovation?


- How might stablecoins or a foreign-country CBDC that has high domestic adoption influence the economy, domestic currency use or payments?
  - **Example:** Could the usage of domestic currency decline in favour of an alternative digital currency, a stablecoin or foreign-country CBDC? If so, how exactly?
- What is the potential role of a CBDC in this environment?
  - **Example:** Would it be beneficial if a CBDC served as a counterweight to these trends?
  - **Example:** What policies and regulations could complement or serve as an alternative to CBDC to manage these risks?


### What risks do stablecoins or foreign CBDC impose on an economy?

Some policy-makers have expressed concern that stablecoins, once launched, could displace usage of the domestic currency in an economy and create significant risks to financial stability or monetary policy. It may transpire that in economies with unstable currencies and low central-bank credibility, users may substitute their currency for a low-volatility stablecoin. This risk is similar to the issue of currency substitution (e.g. substitution out of the domestic currency for US dollars or other reserve currencies) often faced by unstable economies during periods of financial or economic stress. The same questions could apply to concerns over substitution for foreign-country CBDC as well.

It is unclear whether users in these contexts would prefer substituting their domestic currency for these new assets rather than for pre-existing foreign currencies such as the US dollar, if accessible.

Users who adopt a stablecoin or foreign CBDC would face foreign-exchange risk (the value of their currency relative to that of the new asset), frictions associated with operating in digital currencies or foreign CBDC, and potential governance and security risks specific to those assets. If relevant, policy-makers can consider how regulations and policies could mitigate the risks related to the *de facto* adoption of such digital currencies. With regard to foreign-country CBDC, it should also be noted that it may not be accessible to citizens outside of the relevant country, potentially reducing adoption risks.

 See the Appendix to Section 4 for detailed descriptions of the platforms listed above and additional information to accompany the investigation in this section.

 Please answer the questions for this section in the Worksheet for Section 4.

## 5. 'Hybrid CBDC' evaluation

In July 2019, authors at the International Monetary Fund (IMF) proposed the concept of a “synthetic CBDC”, which could also be called “reserve-backed private tokens” or “hybrid CBDC”. Policy-makers considering retail CBDC could review the IMF’s paper, *The Rise of Digital Money*, and the briefer blog post, *From Stablecoins to Central Bank Digital Currencies*, to learn more about this concept.

In this alternative to CBDC, the central bank allows financial institutions such as electronic money or payment service providers (PSP) that do not typically have access to the central bank’s deposit facility to hold reserves at the central bank, enabling stronger safeguards and monitoring of these organizations as well as potentially improving interoperability between different payment systems. For instance, conditions could be included in payment providers’ charters establishing that users of the payment system would have the first *lien* on the provider’s reserves or other assets in the event of bankruptcy. It is important to note that, unlike CBDC, “hybrid CBDC” is not a claim on the central bank in the case of issuer default.

The value proposition of “hybrid CBDC” includes the following:

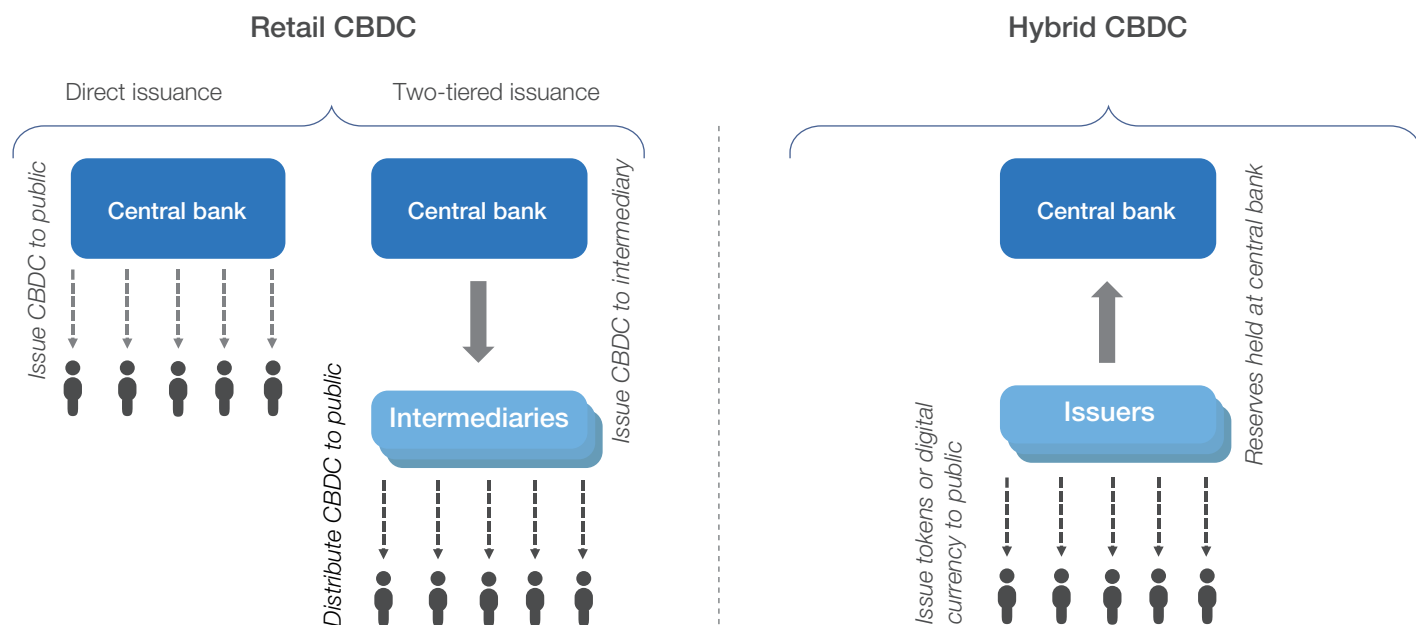
- It allows the central bank to support provision of stable and liquid electronic money by private institutions with safeguards and protections for user funds.

- It represents an alternative to regulation or retail CBDC in addressing payment-system stability and market power risks from widely adopted digital payment providers (including stablecoin providers).
- It could probably be implemented more rapidly than retail CBDC.
- In place of retail CBDC, it would allow central banks to focus on core competencies such as transaction settlement rather than a full suite of retail CBDC components and requirements (two-tiered CBDC also partly addresses this challenge).

Policy-makers who identified retail CBDC as an area of exploration should consider the following questions:

- Is “hybrid CBDC” a potential avenue for the institution? If so, which policy goals or objectives could it help deliver?
- What value does “hybrid CBDC” offer relative to retail CBDC (including retail CBDC issued via intermediaries in a two-tiered structure)?
- Are there statutory or policy constraints that might prevent the central bank from giving access to non-bank institutions?
- What could “hybrid CBDC” in the country look like? Are there specific types of financial institutions it could make sense to include or not include? What types of oversight regimes could be appropriate?

The graphic below portrays retail and “hybrid CBDC”:



See the Appendix to Section 5 for additional information to accompany your investigation of this section.

Please answer the questions for this section in the Worksheet for Section 5.

In the Worksheet to Complete Phase 2, re-evaluate at this stage whether CBDC remains a compelling value proposition. If not, consider pausing analysis of CBDC. It may also be relevant to revisit Section 3, CBDC form, after having evaluated “hybrid CBDC”.

## Phase 3 – Risks evaluation

### 6. Operational risks and financial inclusion in retail CBDC

When considering the introduction of a retail CBDC, the issuing central bank must evaluate the technological and operational risks that can negatively affect users, along with accessibility and financial inclusion. The central bank should, in all cases, set and enforce strong policies that reduce the risks to the general public, ensuring constant CBDC availability and designing back-up strategies and systems.

*What are the technological risks that must be considered prior to CBDC implementation?*

*Network failure and operational risks* – For all forms of CBDC, as payments are integral to the economy, the central bank and policy-makers must seek to enable the greatest degree of system availability possible, implementing safeguards and contingency plans that reduce risks to system interruption. CBDC system availability and continuous 24/7 access should be designed to consider people living beyond the reach of the internet or who do not have regular internet access; this is essential for refugees and people living in remote settings. The system must also protect the availability of CBDC from physical disruption of systems or infrastructure (e.g. large-scale electricity interruptions from storms).

*Cybersecurity risks* – Central banks must create precautions and robust cyber-resiliency policies to reduce risks from cyberattacks. They should operate under the assumption that a cyberattacker has unlimited resources, as it is not unthinkable that the attacker could be a foreign government. Contingency systems such as available sources of physical cash (for a retail CBDC system shutdown) should be put in place to maintain necessary liquidity in the event of an interruption of digital systems.

*How can a retail CBDC be designed to enable greater financial inclusion?*

*Accessibility and financial inclusion* – New CBDC implementation should strive to maximize participation in financial systems and not reinforce existing barriers or erect new barriers to inclusion for vulnerable populations.

- According to the [World Bank](#), 1.7 billion people live without access to any form of identification and are therefore typically excluded from regulated financial services. Without proper design and customer identification policies, populations that do not have access to traditional forms of government-recognized identification may be excluded from CBDC.
- Elderly people are also at risk of exclusion from participation due to their lower than average willingness or ability to engage with technology.
- Those with disabilities such as blindness should be accounted for in CBDC design and development.

Tourists may struggle to make payments in an economy heavily reliant on retail CBDC if ownership is limited to residents and domestic institutions. Accessibility considerations should also include CBDC interoperability with existing payment systems, such as debit or credit cards.

A CBDC should have no or very limited cost to users. Costs related to telecommunications and mobile phones involved in CBDC must be transparent and low to support inclusion (and to increase the value of the CBDC in general). CBDC custody should not rest fully within the mobile phone, so that a customer who loses his or her phone does not lose his or her CBDC holdings.

It may be worth considering whether CBDC accessibility can be improved with technology. It could be possible to meet KYC/AML/CFT goals without mandating the requirement of government-issued identity documents, opening participation to a wider audience and supporting financial-inclusion goals. New digital identity capabilities, such as biometrics or other non-traditional mechanisms, could potentially validate a user's identity. However, policy-makers should be aware that people may be hesitant to use biometrics as identity verification. The security of alternative identity approaches must also be strongly considered.

#### The importance of cash

Physical cash, particularly small banknotes, guarantees financial inclusion more than any other means of payment. Cash serves as a last-resort means of payment and store of value in the event of payment-system shocks and failures. For many, it is also their primary means of payment and savings. The central bank should not develop policies that remove small banknotes from retail use until a fully reliable alternative is available to all members of the population, which may not be possible.



See the Appendix to Section 6 for additional information to accompany this section.



Please answer the questions for this section in the Worksheet for Section 6.

## 7. Data protections and compliance for retail CBDC

Upon issuance of a retail CBDC, the central bank is extending its involvement in the retail payment system, and as a result is also extending its responsibility. It must balance user data privacy goals with AML/CFT requirements and the need to limit illicit activity within the CBDC system.

*What are the main issues related to data privacy for CBDC?*

*Data privacy risks* – User privacy is one of the most important considerations for CBDC. Access to a user's transaction history not only allows for tracking spending habits but can also enable location tracking and identification of sensitive personal data. If retail CBDC is used widely, the monetary authority must design and implement strict user data storage and privacy policies and protections. For instance, protections could ensure users are not unlawfully discriminated against because of their spending habits or targeted for data privacy abuses based on membership of certain subpopulations.

The system must have safeguards to reasonably ensure the security, privacy and confidentiality of transaction and identity data while protecting against unauthorized access, acquisition, alteration, disclosure or destruction of that data. User data privacy should be a priority, not only to protect citizens from the risks of potential state-level surveillance but also to reduce vulnerabilities to external cyberattacks by domestic or foreign parties. Accordingly, CBDC should be designed with as much anonymity as possible, taking into consideration AML/CFT regulations and security policies.


Another potential issue related to user data privacy arises if retail users can employ the retail CBDC of other countries. If foreign-country CBDC has different customer data privacy policies and safeguards, then user data may be vulnerable when people use those CBDCs. Policy-makers may need to consider regulating foreign-country CBDCs to protect the public from data privacy abuses.


### Customer data policy

It might be prudent to develop a user data policy that clearly articulates the rules for data management, access, privacy and custody. It should reduce any applicable conflicts of interest and be clearly connected to governance processes with strict requirements and penalties for violations.

As part of the policy, citizens should receive an understandable explanation of when, how, by whom and for what purposes their data is being collected, used, shared and retained.

*Data access and portability* – New CBDC implementation should strive to maximize user agency and trust. Users should have a right to access and share their data as they choose in a structured and standardized format. They must also have the right to dispute the accuracy of their data and to have erroneous data promptly corrected, updated or deleted.

 See the Appendix to Section 7 for information about modern cryptography techniques that can provide transaction privacy and confidentiality while meeting regulatory and other goals.


 Please answer the questions for this section in the Worksheet for Section 7.





## 8. Evaluation of macroeconomic and financial risks and opportunities

The policy-maker should next evaluate the main macroeconomic and financial risks and opportunities that a CBDC presents. Several points within this section correspond with issues identified in other sections of this toolkit; where relevant, these concepts can be revisited or revised.

- What important macroeconomic and financial goals or opportunities could this form of CBDC enable in the economy?
- Which macroeconomic and financial risks is it important to consider? Which solutions or strategies can mitigate risks?
- Who will have access to the CBDC, in terms of domestic and foreign citizens and financial institutions?
- What is the anticipated effect on banks? How are the roles and business models of banks expected to change after CBDC is deployed?
- Which additional types of firms would be positively or negatively affected by CBDC?
- What are the effects of CBDC (interest-bearing or not) on monetary policy?
- What would be the implications of CBDC for the domestic political environment, government institutions and geopolitics?
- Which macroeconomic policy decisions should be made with respect to CBDC?
  - Will CBDC be used to implement monetary policy goals and, if so, how? Will a CBDC be allowed to implement negative interest rates?
  - Will there be any significant cash policies implemented alongside CBDC?
  - Will there be lending activity associated with a retail CBDC? Why or why not?
  - Would a CBDC interact with existing policies related to international capital mobility?

 Revisit the Appendix to Section 2 for information about the main macroeconomic and financial issues related to CBDC that can inform the answers to the questions in this section. See the Appendix to Section 8 for research references to accompany this section.

 Please answer the questions for this section in the Worksheet for Section 8.

 In the Worksheet to Complete Phase 3, list the top benefits of the CBDC envisioned, as well as the main risks and downsides. Do the benefits outweigh the identified risks and downsides? If not, consider pausing or stopping the evaluation of the CBDC. If they do, consider revisiting Step 3, CBDC form, if relevant. Once this is complete, proceed to Phase 4, Designing CBDC.

## 9. CBDC design elements

In this phase, the policy-maker considers how the CBDC should be designed in order to achieve the target outcomes and mitigate the risks identified in the preceding sections of this toolkit.

- *Availability/access* – For which entities should the CBDC be available? For retail CBDC, will foreign citizens, tourists or other parties have access? For wholesale CBDC, will foreign commercial or central banks, non-bank corporates, investment funds, stablecoin providers or systemically important financial institutions have access?
- *Custody and storage* – Where will the CBDC be held? Will it be held with accounts directly or indirectly at the central bank or in digital wallets of various forms? Will a two-tiered system be used?
- *Anonymity* – To what degree is the user, account balance and transaction information private or pseudonymous? Which regulatory, legal or compliance policies constrain anonymity? What are the goals of the CBDC with respect to transaction tracing, monitoring or anonymity? Does the degree of anonymity correspond with the transaction sizes?
- *Account and transaction limits* – Should there be limits or constraints on transaction size or total account balance?
- *Interest payments* – What is the interest rate policy for the CBDC? Should a retail or wholesale CBDC pay interest (including, possibly, a negative one)? How do monetary policy and financial stability goals and risks determine the appropriate interest rate policy?
- *Conversions and redemption rates* – What are the conversion or redemption policies related to a retail CBDC with respect to bank deposits or cash? For a wholesale CBDC?
- *Settlement times and finality* – Should settlement be near-immediate and available 24/7/365 (more “cash-like”), periodic or delayed in order to allow more time for recourse and compliance requirements? Which compliance and other laws constrain settlement and finality options?
- *Programmability features* – For what purposes and capabilities should the CBDC be potentially programmable, if any? (For instance, cross-border “atomic” interbank transactions.)
- *Lending activity* – Should central banks or intermediaries conduct lending activity on CBDC?



See the Appendix to Section 9 for information and research references to accompany this section.



Please answer the questions for this section in the Worksheet for Section 9.

## 10. Technology choices, considerations and risks

After the target CBDC design is fully defined, the policy-maker can then investigate and identify the most suitable technology to deliver the CBDC. It is valuable to wait until as late in the process as possible to identify the target technology solution, suspending preconceived notions in order to allow for more flexibility and informed technology decisions. CBDC issuance and design is largely a technology-agnostic decision. Importantly, policy-makers should conduct their own research and fully evaluate technology solutions and providers, and they should be wary of simply selecting a convenient technology solution. Given the target CBDC identified in the preceding sections of the toolkit, evaluate the following:

### Core functionalities

Which characteristics are priorities?

- Transaction scalability and performance
- Privacy and confidentiality of transaction information
- Transaction finality
- Interoperability with existing payment systems and infrastructure.

### Technology assessment

- What are the trade-offs, pros and cons associated with various technology options?
- If DLT is considered, who would serve as validating nodes? Which platform and consensus algorithm may be relevant to employ and why?
- Which technology providers, services or experts can support implementation?
- Which technologies may be best suited, and why?

### Cost assessment

- What cost constraints exist for the CBDC implementation?
- How much will it cost to implement this target technology?
- How much maintenance will be needed with this technology and what are the associated costs?

### Cybersecurity and resilience

- How cyber resilient is the platform, and why? What are the CBDC's cybersecurity vulnerabilities or "attack surfaces"?
- What are the appropriate cyber-resilience requirements? How can the system's cyber resilience be studied?
- Which cybersecurity standards and techniques must be identified to reduce cyber risks?
- What are the ongoing cybersecurity monitoring requirements for this technology implementation? How will monitoring and upgrades be conducted so as to be minimally disruptive?


### Additional considerations

- How can vendor lock-in be avoided?
- How much has this technology been deployed and tested in the world? Is there sufficient software-developer availability and expertise to support the platform?
- How will this technology integrate with legacy systems and processes?
- How will this technology interoperate with existing and future financial systems?
- What are the ongoing monitoring requirements of this technology?
- How will the CBDC be minted (digitally created)?

### Interoperability and integration

Interoperability with existing and future systems is critical to ensure the adoption and longevity of CBDC. If multiple central banks issue CBDC, there may be an opportunity for the coordination of international standards to ensure technical interoperability between a CBDC infrastructure and payment and banking systems, and between cross-border CBDCs. Policy-makers should also consider the technology infrastructure that would support cross-border CBDC and currency-exchange operations, and retail CBDC for tourists, if relevant.

 See the Appendix to Section 10 for information and research references to accompany this section.

 Please answer the questions for this section in the Worksheet for Section 10.

## 11. Governance

Governance entails the rules and practices that govern the life cycle of the CBDC, from co-design to issuance. Good governance is a crucial ingredient of a successful deployment and should not be overlooked. Policy-makers should use the list below as a starting point to define governance with the appropriate stakeholders.

### Legal evaluation

- Which requirements exist with respect to laws and legal supervision?
- Would a retail CBDC be politically feasible? How might political limitations affect CBDC design? (For instance, would a negative interest rate on retail CBDC be politically tenable?)
- How will public interest in CBDC be determined?
- Should there be any special consideration if there is an upcoming election cycle?
- Are CBDCs compatible with existing financial market infrastructure (e.g. the rulebooks of payment and settlement systems) and what legal validation needs to take place to ensure that transactions on financial market infrastructure are legally enforceable?
- Are there additional requirements and standards that custodians and intermediaries would need to comply with in relation to CBDCs (e.g. with respect to standards around safeguarding private keys, secure storage etc.)?
- How would CBDC be treated from a prudential regulation or regulatory capital perspective? Are there prudential risks over and above those relating to traditional fiat currencies that must be considered?

### User engagement

- User engagement and consultation are critical for effective CBDC design; users should be engaged as early in the CBDC process as feasible.
- How can end users (the public, commercial banks etc.) be consulted on the CBDC concept and provide input to the design and testing process?
- Which solution requirements exist for usability, user interfaces, identity and key management, privacy and security?
- It could be valuable to provide a user guide or FAQs to various classifications of participants, with educational resources and background information on how to successfully engage with the CBDC.

### Financial management

- How will project financial management and monitoring occur?
- Which, if any costs might private entities have in providing the CBDC, and who is responsible for managing those costs?

### Identification of performance criteria

Performance criteria should be identified before the launch of the CBDC in order to: 1) establish relevant targets and goals; 2) measure success and identify areas of improvement; 3) instil accountability in the programme; and 4) ensure success in meeting risk management and security requirements. A specific evaluation frequency (e.g. weekly or monthly) should be determined.

### CBDC termination

A termination plan could be identified before project deployment. The plan might include the following considerations:

- What conditions would indicate that the CBDC programme should be terminated?
- Which obligations would need to be met before termination in order to reduce disruption and risks to users?
- How can the safety of public CBDC savings be ensured?
- How would CBDC be destroyed?

### Additional considerations

- How will the environmental impact and footprint of the CBDC be monitored, evaluated and controlled?
- Can a third party such as a law-enforcement institution freeze CBDC account assets, and under what circumstances?
- What other deployment risks and unintended consequences must be considered?



See the Appendix to Section 11 for additional information to accompany this section.



Please answer the questions for this section in the Worksheet for Section 11.



By the end of Phase 4, the policy-maker should have a clear outline of the CBDC design, technology choices and requirements, and governance processes. Consider whether this formulation corresponds with the goals and constraints identified in Phase 1 (preliminary analysis). If not, revisit the appropriate sections of the toolkit. When ready, fill in the Worksheet to Complete Phase 4 before proceeding to Phase 5.

### 12. Implementation strategy

The purpose of this section is to inform vital considerations and requirements before implementing the CBDC solution envisioned in the toolkit.

Policy-makers should consider the following issues, among others, as part of a CBDC implementation strategy:

#### Experiments and prototyping

The CBDC solution may need to be tested or introduced on a trial basis prior to full deployment. For example, the policy-maker could engage in experimentation such as a proof-of-concept (PoC) or pilot, which can test against defined research goals and provide valuable insight into a potential CBDC deployment. For both experimentation and deployment, the central bank should work collaboratively with the stakeholders identified in Section 1, including relevant public-sector, regulatory, private-sector, civil society and technology parties.

#### Methodology

Furthermore, the CBDC design and development process should take an agile and flexible approach, adjusting according to testing, feedback and new research. For user-facing components, it should involve user input, testing and interviews to inform effective user-interface (UI) and user-experience (UX), taking a “user-centric” approach where possible. This methodology will strengthen adoption and usability.

#### Public engagement for retail CBDC

For retail CBDC, a strong public-engagement effort is imperative. Further, education and informational programmes should be created so that users can understand the advantages and risks related to the CBDC. One example of an important risk consideration for users is password or key management; teaching safe use of passwords and private keys is critical. The central bank could also provide user guides or FAQs about the CBDC to the public. The central bank should also consider a public communication strategy that could include town halls and live engagement.

### Collaborative experimentation and deployment


Policy-makers could consider whether to cooperate with other central banks, international organizations, commercial banks or other governmental or financial institutions in the development of CBDC. Collaboration can strengthen knowledge-building and inform effective CBDC design and deployment, potentially leading to greater adoption and deployment success. International organizations that conduct research or other efforts related to CBDC include the IMF, the Inter-American Development Bank and the Bank for International Settlements, among others. Further, engagement with commercial banks may be beneficial or necessary for retail or wholesale CBDC development. Many experiments have involved commercial banks, strengthening cooperation with the private sector and the financial system.


#### Introduction plan

Lastly, the central bank should develop a CBDC introduction plan that considers vital factors such as:

- The scope, nature and specific deployment strategy for a PoC, pilot or full deployment
- The timeline of CBDC introduction
- A strategy to introduce and monitor the CBDC roll-out, following the appropriate governance policies identified in Section 11
- Policies the central bank will put into place to ensure a controlled roll-out of CBDC that does not have negative impacts on financial stability.

 See the Appendix to Section 12 for additional information to accompany this section.

 Please answer the questions for this section in the Worksheet for Section 12.

 By the end of Phase 5, the policy-maker should have a clear vision of the target CBDC, along with governance policies and an implementation plan. The policy-maker should also re-evaluate the costs and risks associated with CBDC against the objectives and advantages, confirming whether CBDC remains compelling. If so, the next steps towards development can be taken.

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