Driving Financial Inclusion Through Central Bank Digital Currencies

A Methodology for CBDC Implementation

June 2025

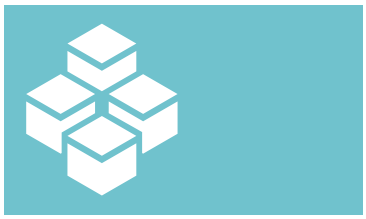
Acknowledgements
This publication is a product of the UNDP Global Centre for Technology, Innovation and Sustainable Development. The report has been authored by Heng Wang (Professor of Law in the Yong Pung How School of Law at Singapore Management University); edited, managed and reviewed by Francesca Puricelli (Sustainable Finance Specialist at the UNDP Global Centre in Singapore).

The authors would like to thank Prerna Saxena and Shruti Sharma from the Better Than Cash Alliance team, who peer reviewed and provided key insights for the report. This report has also benefited from the contributions and support of Joe Hooper (Director at the UNDP Global Centre in Singapore). We thank Li Wen Ng for the design of this report.

About UNDP: UNDP is the leading United Nations organization fighting to end the injustice of poverty, inequality, and climate change. Working with our broad network of experts and partners in 170 countries, we help nations to build integrated, lasting solutions for people and planet. Learn more at undp.org or follow at @UNDP.

About the UNDP Global Centre for Technology, Innovation and Sustainable Development: The Centre is a joint initiative by the Government of Singapore and the UNDP which aims at identifying and co-creating technological solutions for sustainable development. The Centre curates partnerships, identifies solutions and connects partners and innovations with UNDP's Global Policy Network and development partners.

Table of Contents



Executive summary

This publication is intended for UNDP staff and development practitioners working in financial inclusion, digital finance, and public sector innovation, as well as government officials exploring the role of central bank digital currencies (CBDCs) in advancing inclusive development. As CBDCs represent one of the most rapidly evolving and experimental areas of digital finance, continuous learning and adaptation are critical. This paper offers a foundational starting point: a practical, adaptive methodology to guide countries and advisors as they navigate this complex and emerging field.

With hundreds of central banks engaged in some form of CBDC-related work, this paper explores how CBDCs—particularly retail CBDCs—can help overcome persistent barriers to financial inclusion in emerging economies. These include high transaction costs, limited identity documentation, poor connectivity, and usability challenges. CBDCs hold potential to improve the accessibility, affordability, and relevance of financial services for unserved and underserved populations, especially when designed with offline functionality, simplified identification, and inclusive interfaces.

The methodology presented is organized into five key stages: (1) understanding financial inclusion barriers, (2) CBDC preparation, (3) user-centric design and prototyping, (4) piloting, and (5) implementation. Each stage incorporates concrete actions—from stakeholder mapping and cost-benefit assessments to technological stress testing and regulatory reviews. A strong emphasis is placed on user-centered design, ensuring that CBDCs respond to the needs of vulnerable populations, close digital literacy gaps, and build user trust. Privacy protections, interoperability, and viable cost-recovery mechanisms are also central to this framework.

Ultimately, this approach seeks to balance innovation with risk mitigation, enabling countries to learn by doing while fostering inclusive, secure, and sustainable financial ecosystems. By advancing this dialogue, we hope to support policymakers and practitioners as they co-create CBDCs that contribute meaningfully to financial inclusion and the broader Sustainable Development Goals (SDGs).

What are central bank digital currencies?

In this publication, we delve into the world of central bank digital currencies (CBDCs) and how central banks can best be advised on their adoption, taking into account their profound implications for financial inclusion. As of early 2025, over a hundred central banks around the world are engaged in some form of CBDC-related work, and with more and more governments exploring the potential of CBDCs, there is a greater need to engage with various aspects of this topic, including its design, given its potential to foster financial inclusion. UNDP has a long history of promoting technological and digital financial innovations that help advance financial inclusion and the SDGs more broadly. Our teams have worked with various countries on digital finance and infrastructure innovations enabling underserved business segments, such as MSMEs, to access more sophisticated financial services or on enabling micro-savers to become micro-investors in green infrastructure projects, or on harnessing the developments in Distributed Ledger Technologies (DLTs) to advance innovative financial instruments for private capital mobilization for nature. Given UNDP's expertise and leadership in this space, UNDP's involvement in this discussion can help better support member states as they navigate this changing landscape.

Unlike e-money, stablecoins, or private digital assets like Bitcoin, CBDCs are digital forms of national currencies ("fiat currencies") issued by central banks. CBDCs can serve as a novel form of central bank money and function as new financial infrastructure. A CBDC can take two forms: "retail CBDC", designed for broad public use in retail transactions, or "wholesale CBDC", tailored for financial institutions and wholesale markets to facilitate large-value interbank transactions and settlements. In particular, retail CBDCs are used by the public and businesses for transactions and storing value. The potential use cases for CBDCs are diverse, including salary payments, taxation, e-commerce, Government-to-Person ("G2P") Payments, social protection, and climate resilience disbursements. CBDCs can also utilize the technology of "smart contracts", which are automatable and enforceable agreements. Smart contracts hold promise in fulfilling a wide range of functions, such as delivering public services to remote (unserved or underserved) areas and managing prepaid fund.

	Cash	Central Bank Reserves	Commercial Bank Money	E-money	Cryptocurrency	CBDC
Accessible to retail users	✓	✗	✓	✓	✓	✓
Digitally stored and transferred	✗	✓	✓	✓	✓	✓
Liability of the central bank	✓	✓	✗	✗	✗	✓

Figure 1. How CBDCs compare to other forms of digital and non-digital currencies.

In terms of CBDC current development, 93% of 86 central banks surveyed around the world by the Bank for International Settlements (BIS) are engaged in some form of CBDC-related work. In 2024, within the 30 respondents of the International Monetary Fund (IMF) survey on Sub-Saharan Africa, 23 respondents stated that their central bank either has begun or plans to start research, experiments, or development related to CBDCs. The Bahamas, Eastern Caribbean, Jamaica, and Nigeria Central Banks have already issued retail CBDCs, but are currently facing challenges such as adoption rates. For example, the SandDollar, the Bahamas' CBDC, represents a small fraction of the currency in circulation, with the number of registered wallets equivalent to approximately 25% of the population.

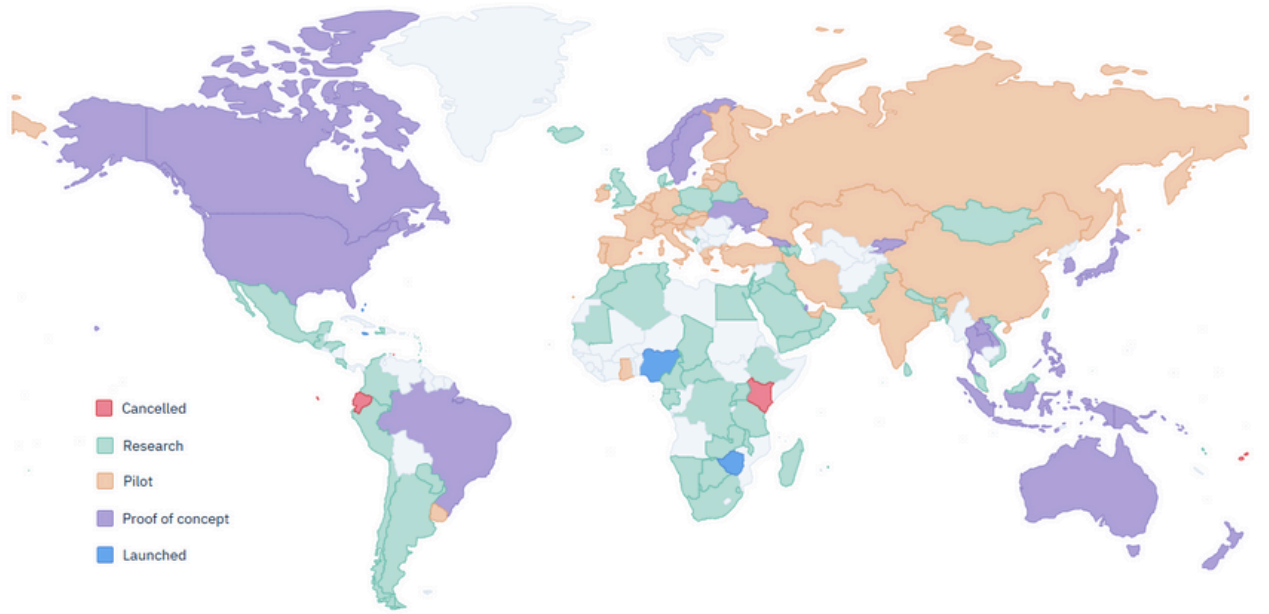


Figure 2. CBDCs status as of June 2025 (source: www.cbdctracker.org)

Various countries are actively exploring the potential use of CBDCs, particularly retail CBDCs, to improve financial inclusion. CBDCs, if properly designed and managed, may have the potential to enhance financial inclusion by addressing access and price barriers. In terms of improving access to financial services, CBDCs can be designed to reduce identity management requirements (particularly Know Your Customer [KYC]) in low-risk contexts. This could allow the use of digital currencies without the need for bank accounts or minimum balances and offer offline functionality to mitigate the impact of physical remoteness. In addition, by lowering transaction costs for financial services and providing cheaper payment services, CBDCs have the potential to address price impediments and make financial services more affordable for the unserved and underserved populations.

BOX 1: FRAMING CBDCS WITHIN DIGITAL PUBLIC INFRASTRUCTURE (DPI)

CBDCs are not standalone tools. To be effective and inclusive, CBDCs should be viewed as one layer of a broader Digital Public Infrastructure (DPI) framework. DPI refers to foundational digital systems—such as digital identity, interoperable payment systems, and consent-based data governance—that enable societies to safely and inclusively participate in the digital economy.

Examples like India's India Stack and Brazil's PIX illustrate how fast payment systems, combined with digital IDs and data empowerment, may create fertile ground for CBDCs to thrive. The focus on DPI further underscores its role in shaping inclusive and secure digital economies. As such, countries should avoid siloed CBDC pilots by sequencing reforms: robust digital ID and fast payment systems should ideally precede or accompany CBDC rollouts. Anchoring CBDC planning in DPI maturity helps ensure interoperability, builds user trust, and maximizes impact.

In this paper, we focus on retail CBDCs and their design and implementation process. We will do so by relying on a user-centric approach to implementing CBDCs, as this is crucial to ensure that they effectively address financial inclusion barriers by meeting the specific needs of the unserved and underserved populations. This approach involves placing users at the centre of the discourse, and tailoring CBDC design to overcome their unique challenges, such as limited digital literacy, poor infrastructure, or high transaction costs, while prioritizing accessibility, affordability, and ease of use. Placing users of retail CBDCs – businesses and individuals – at the centre, we asked ourselves three key questions: Do users understand CBDCs? Do they know how to use them? And finally, do they want to use CBDCs?

Do users understand CBDCs?

Users of retail CBDCs shall have access to not only the infrastructure but also the necessary knowledge about CBDCs. For example, the public should understand how to open a CBDC wallet and use a CBDC without a bank account. Accessing the knowledge and infrastructure necessary for CBDCs can vary based on factors such as offline or online functionality, access to data, and, of course, mobile phone.

Do users know how to use CBDCs?

Key issues regarding CBDCs include convenience (e.g. seamless conversion into cash), and the technological preparedness of users (e.g. owning phones). What happens to a user's CBDC if their device is lost? Can CBDCs easily operate offline even during disasters? The CBDC access by feature phones and other hardware (such as cards) helps to promote the adoption of CBDC. This will require maintaining sufficient coverage and capacity of digital infrastructure (including POS and last-mile connectivity) over time.

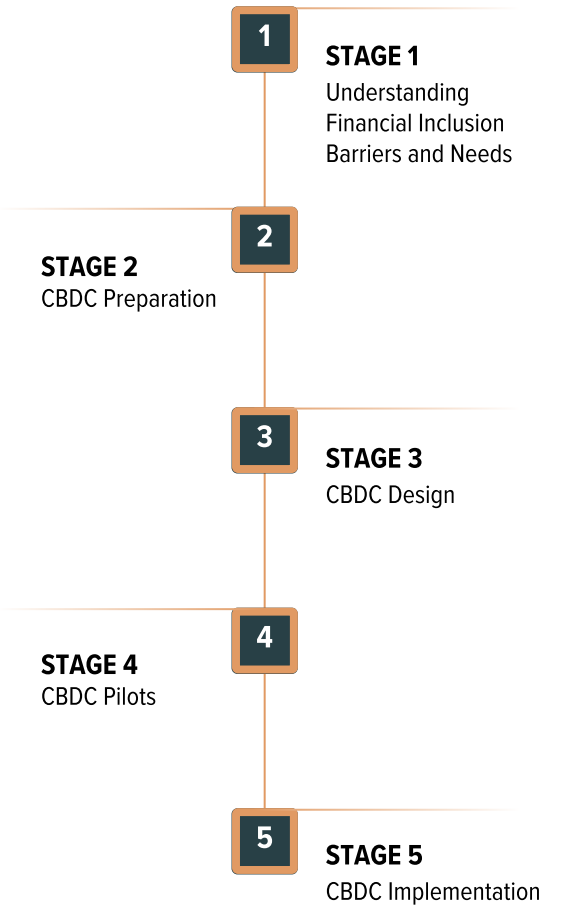
Do users want to use CBDCs?

Individuals and businesses will weigh factors such as privacy protection, costs, reliability (e.g. user support, dispute resolution), accessibility, and security when considering retail CBDCs. Users often compare CBDCs with traditional methods – like cash, credit cards, and fast payment systems, highlighting challenges such as CBDC dispute resolution mechanisms currently falling short of those in global card payment systems. Building trust in CBDCs and the issuing central bank is pivotal.

Steps of CBDC implementation

The following section outlines in detail each advised step for the development and adoption of CBDCs by a country, ranging from their design, their testing, to their implementation.

We have grouped activities in five stages, as follows:



1 STAGE 1: UNDERSTANDING FINANCIAL INCLUSION BARRIERS AND NEEDS

Before implementing a CBDC, a country must first assess where it currently stands on the financial inclusion spectrum. For some this might mean addressing the needs of the rural unbanked, while for others it might involve improving access for women, micro-entrepreneurs, or marginalized communities. Identifying context-specific challenges—such as lack of infrastructure, digital and financial literacy, or social and cultural barriers—is essential to ensure the CBDC design aligns with the target groups' unique needs. Central banks must therefore start by articulating their goals, for example: *Are CBDCs necessary? If so, when and why? Is the objective to provide access to basic banking services, promote savings, enable small-scale lending, or meet other needs?* Understanding these goals will help shape the CBDC's functionality, whether it is enabling digital wallets for microtransactions or simplifying cross-border remittances at lower costs. Hence the first stage in CBDC implementation is to identify a country's unique barriers to financial inclusion and its users' needs.

The following steps can guide during this stage:

- ❑ Set up a team of regulatory, technology and foresight experts, and a coordination mechanism for the different departments and agencies involved (e.g. regular coordination meetings between central banks, financial regulators, law enforcement agencies, and other agencies).

- ❑ Identify unserved and underserved populations (e.g. groups living in rural areas, low-income groups, senior citizens).

- ❑ Identify financial inclusion barriers, including the barriers that CBDC plans to reduce based on the assessment of other financial infrastructure (e.g. fast payment systems).
  - In order to ensure that CBDC design actively closes, not widens, existing gender gaps, a gender-informed analysis of barriers such as shared phone usage, low digital literacy, or informal identity systems is recommended. CBDC pilots, such as those in Ghana (eCEDI), have shown the value of community-led training and agent-assisted access for rural women. Design features like tiered zero-KYC wallets for low-value usage by women, shared device authentication models, and onboarding via self-help groups (SHGs) or community agents are some examples of gender-informed design features.
  - For more comprehensive guidance on this step, please refer to **Annex 1**.

- ❑ Understand the needs of users, including those of the unserved and underserved populations. Will CBDCs offer unique functionalities to meet specific needs unmet by other financial infrastructure (e.g. fast payment systems), such as offline access or no credit risks for payment system actors through CBDC as a direct central bank liability? The decision to proceed hinges on confirming the desirability of building new CBDC infrastructure as demonstrably superior to enhancing existing systems for achieving these objectives (including evaluating comparative efficiency for use cases like cross-border remittance). Furthermore, this requires a thorough assessment demonstrating that risks (as discussed below)—such as the cost recovery and resilience challenges of offline functions, cybersecurity threats, and potential user acceptance issues—are fully understood and manageable. Finally, there must be confidence in the adequate technical, operational, legal, and oversight capacity of the central bank and other stakeholders to implement and develop the CBDC over time.

- ❑ Explore the factors that affect the cost recovery of CBDC, including funds to develop and maintain CBDC-related “hardware” (infrastructure) and “software” (the technologies associated with encryption, digital wallets and cyber security). While low-cost or free use of CBDCs would help to promote its accessibility, cost recovery is important to ensure accessibility in the long run. CBDCs are likely to be resource-intensive; they require funds and expertise to develop ever-evolving CBDC infrastructure that is secure and resilient (e.g. upgrading of software and hardware such as data centres and terminal devices of merchants), and provide resources for different purposes (such as the education of users, the fight against fraud, dispute settlement). CBDCs call for the continuing investment of not only

central banks, but also other stakeholders (such as payment service providers (PSPs) and merchants). Therefore, low fees need to be balanced with cost recovery.

- ❑ Identify risks.
  - For this step, please refer to **Annex 2**.

2 STAGE 2: CBDC PREPARATION

Once the financial inclusion barriers and needs are understood, the next stage is to prepare for CBDC implementation by setting a strong foundation. This involves revisiting identified barriers and ensuring that the CBDC's design targets these effectively. Key preparatory steps include conducting a cost-benefit analysis, allocating necessary resources, and defining clear roles for all stakeholders. A comprehensive workplan, coupled with a robust risk management strategy, will guide the coordination between public and private sectors, ensuring that the groundwork is ready for subsequent stages.

The following steps can guide during this stage:

- ❑ Revisit barriers to financial inclusion that the CBDC plans to reduce, and design indicators to track the improvement of financial inclusion. Examples of indicators include metrics on the infrastructure (such as coverage, capacity and security); the CBDC adoption rate; the availability of offline functions in the case of no electricity/internet access; the CBDC usage in remote areas; the CBDC usage by vulnerable groups; the acceptance of CBDC by merchants; the number of CBDC use cases (e.g., payments); the transparency of the CBDC system (e.g., data collection, usage and destruction, dispute settlement arrangements, CBDC-related charges if any); and the convenience of CBDC including the seamless conversion into cash. Other examples of indicators focusing on inclusion could be the percentage of women completing three or more CBDC transactions per month; the percentage of users accessing additional/value-added services (e.g., microloans, savings) via CBDC-linked apps; and the grievance redress resolution rate within x days.

- ❑ Conduct a cost-benefit analysis, including estimating the costs of developing and maintaining CBDC "hardware" (data centers and other infrastructure, related costs such as energy costs) and "software" (technologies, user support centers, dispute settlement arrangements, sustainable CBDC use cases whose costs can be recovered), and estimating the benefit of CBDC (such as reduced management costs).

- ❑ Explore other (non-monetary) implications of CBDC, such as implications for financial stability, cyber security, and environmental sustainability, and identify mitigation strategies to such implications and test assumptions (e.g. CBDCs lowering access barriers to financial inclusion) to decide whether CBDC project needs to continue.

- ❑ Define the division of labor between different stakeholders.

- ❑ Define the required budget and institutional resources (including the resources to build data centers and other infrastructure).

- ❑ Develop a workplan, inclusive of the recruitment of experts, the joint work of the public sector and the industry, and/or the outsourcing of certain CBDC work.

- ❑ Develop a risk management plan (with contractual clauses, resiliency standards, solution in the cases of stolen CBDC-related devices, etc.).

- ❑ Based on the above, conduct an assessment to evaluate key factors, ranging from policy environment and legal framework to technological readiness of stakeholders, and cost factors.
  - **Policy Environment:** How supportive is the current policy framework towards digital financial services? Are there protections for consumer rights, privacy, and data security?
  - **Legal Framework:** Are there legal constraints that need to be addressed, such as outdated regulations preventing digital identities or accounts?
  - **Technology Readiness:** Is the digital infrastructure robust enough to support CBDC adoption, including mobile networks, digital ID systems, and cybersecurity?
  - **Cost Factors:** How affordable will CBDC access be for the target population? Are there provisions for reducing the costs of CBDC transactions to make them accessible to low-income individuals?
  - **Complementary Policies:** What other policies or reforms need to be in place to support CBDCs, such as financial literacy programs, investments in digital infrastructure, or social safety nets?
  - More examples are available in **Annex 3**.

To ensure that CBDC systems offer a globally endorsed foundation for responsible and inclusive digital finance systems, the UN Principles for Responsible Digital Payments can be anchored into this stage, to strengthen user safeguards, particularly in lower-capacity regulatory environments. For example, the principle *"Design for Individuals/Prioritize Women"* could guide simplified onboarding, shared device models, and interface accessibility; the principle *"Make Recourse Clear"* could inform the integration of user dispute mechanisms into CBDC wallets, with regulator-linked hotlines or built-in help buttons; and the principle *"Prioritizing Transparency, Fairness, and Choice"* could shape consent-based data use and wallet-tiering models.

TIPS FOR STAKEHOLDER ENGAGEMENT DURING STAGES 1 & 2

- Identify, map and engage with stakeholders, including stakeholders that help to solve financial inclusion issues (e.g. telecommunication operators, commercial banks, payment service providers)
- Understand the needs, positions, concerns, and constraints (e.g. budget constraint) of different stakeholders
- Establish an engagement arrangement such as a forum, and develop a stakeholder network to provide different types of knowledge and inputs
- Understand social, economic, and regulatory environment, including social values, history, and habits of different users
- Seek inputs on design options (e.g. CBDC policies, dispute settlement arrangements, measures to fight against fraud and scams, cyber security arrangements, digital and financial literacy initiatives, CBDC regulations)
- Develop an effective communication strategy and related materials, tailored to the different target groups.

3 STAGE 3: CBDC DESIGN, INCLUDING PROOF-OF-CONCEPT (POC), AND PROTOTYPES

CBDC designs should ensure that CBDCs offer low-cost and safe electronic payment services to unserved and underserved populations, reducing costs (like cash withdrawal and management costs). The low-cost and safe CBDCs are important for individuals and merchants such as those marginalized by the prevailing financial infrastructure. That said, such advantages may already exist in the form of various mobile money and real-time payment systems. Therefore, CBDCs need to show other potential advantages such as offline payments, accessibility by the public (including vulnerable people such as people with motor, cognitive, or sensory disabilities) to direct claims over a central bank in the digital age, and programmability. Another critical issue is whether CBDC users should receive refund for losses caused by fraud, unless the loss is due to the user's own fault.

Beyond cost savings, CBDCs can serve as a gateway to more sophisticated financial services. Design variables include allowing non-banking financial institutions to distribute CBDCs, which could improve access to credit information. With customer consent, transaction data from CBDCs could be shared with financial institutions (e.g. credit providers) as an alternative to traditional collateral or detailed credit histories, while ensuring data protection. Such credit information could enable financial services to be tailored to users' needs (e.g. loans). Integration with other initiatives, such as open banking and instant payment systems, can also enhance their utility and reach. Through integration with e-commerce, CBDCs can also provide access to a wider range of products and services at more favourable prices, encompassing e-commerce options that often reduce the costs of goods and services. Meanwhile, the design of CBDCs necessitates robust privacy protection to address privacy concerns, and the provision of digital public infrastructure to facilitate such services.

Careful design is necessary to prevent unintentional or inadvertent exclusion, especially taking into account the financial literacy gaps. This is relevant for the end-to-end processes of CBDC, ranging from CBDC issuance to dispute settlement. Efforts are needed to raise awareness and build (digital) capacity for the populations. Simplifying access to CBDCs, including for vulnerable groups, is also essential. This involves ensuring easy access to CBDC wallets, designing CBDC interfaces that are easy to use, and explaining the terms and conditions in simple language. Access requirements (such as whether and what proof of identity is needed to open CBDC wallets), user interfaces (e.g. easy and straightforward instructions for people with low literacy) and terms and conditions should meet user needs. This includes catering to users with disabilities and those new to financial services. CBDC users should also be aware of which agencies handle complaints and disputes, and resources should be provided to support users in seeking remedies.

This design stage focuses on translating preparation into tangible plans and initial trials. It involves creating a secure and resilient CBDC system that adheres to regulatory standards while ensuring scalability and long-term viability. This stage is critical for balancing innovation with risk mitigation to create a CBDC design that addresses financial inclusion effectively.

The following steps guide the design stage:

- ❑ Review and update the CBDC team, by expanding its members based on newly identified needs of regulatory, technology and business nature.

- ❑ Explore secure and resilient technology designs that ensure, inter alia, regulatory compliance.

- ❑ Design choices that preserve long-term commercial viability, including the cases where CBDCs serve as a gateway to more sophisticated financial services.

- ❑ Test assumptions (e.g. test if CBDCs are lowering access and price barriers) through ways like cost-benefit analysis.

- ❑ Design adaptive governance structure, including regulatory/compliance considerations in technological designs and risk management
  - **Deep-dive on data governance and risk management:** Data includes a large amount of personal, transaction, and financial data. If properly managed, data sharing may be used for purposes such as developing new applications and facilitating AML/CFT checks. This brings benefits such as efficiency gains. Such benefits shall be carefully balanced with the imperative to safeguard privacy (including the protection of personal data) and prevent irreversible data loss. Privacy protection would likely lead to tiered CBDC wallets: lower tier wallets have lower physical or digital user identification requirements and low ceilings for CBDC holding and transactions, higher tier wallets have higher user requirements and high ceilings for CBDC holding and transactions. Data governance deserves special attention. This involves the question of whether a central bank will hold the records of CBDC holders, how and where to store data and update the records, and whether users can delete their CBDC data.

BOX 2: DATA GOVERNANCE AND RESPONSIBLE ARTIFICIAL INTELLIGENCE (AI)

Artificial Intelligence (AI) is likely to be embedded in CBDC ecosystems, such as for fraud detection, credit scoring, or automated Know Your Customer (KYC) activities. For example, Brazil's Real Digital pilot and other countries like India explored using AI to detect suspicious transaction patterns. Responsible AI refers to creating and implementing artificial intelligence systems in a manner that is ethical, transparent, and aligned with societal values and norms. It ensures accountability, minimizes bias, and promotes fairness to prevent harm and benefit humanity as a whole. Key principles of responsible AI include:

- **Explainability:** AI systems should provide understandable and interpretable outcomes so users and regulators can grasp how decisions are made.
- **User Consent:** Users should be informed and have control over how their data is collected, used, and shared by AI.
- **Bias Mitigation:** AI must be designed to detect and minimize discriminatory outcomes, ensuring fairness across different demographic groups.

These principles help ensure AI technologies are trustworthy, inclusive, and accountable.

- ❑ Explore a CBDC sandbox or the like (e.g. simulations to test different technology architectures).

- ❑ Finalize a prototype that can:
  - Test the regulatory approach and CBDC regulatory requirements,

including CBDC data regulation (e.g. regulation concerning data lifecycle management, the access to data with user consent, and competition), privacy protection, the requirements regarding the terms and conditions of CBDC, the restrictions on CBDC use, the requirements regarding the handling of complaints and disputes;

- Test the technology plan (the technology being developed by the central bank and/or vendors, the choice of technology platform, CBDC wallet and app design), develop functions (offline payment functions, and the cash withdrawal of CBDC if needed) and detailed technology requirements (interoperability and cyber security requirements, requirements to promote the CBDC access by vulnerable people, the number of transactions that can be processed per second, measures to prevent scams);
- Test the performance of "hardware" (infrastructure) and "software", including their resiliency in the circumstances of system breakdown, transaction errors, tampered user devices (cell phones) and cyberattacks, natural disasters, and problematic internet and electricity supply;
- Test the indicators and different use cases (e.g. retail payments, government-to-person payments) with commercial banks, payment companies, technology companies, users and other stakeholders, and seek feedback;
- Test the governance arrangements of the CBDC, including:
    - The response to digital divide and unlawful acts (e.g. CBDC wallets opened with stolen ID identity documents, money laundering);
    - The viability of funding, intellectual property, communication, and other arrangements, including those for resilient infrastructure;
    - The feasibility of CBDC business models regarding major use cases;
    - The effects on financial inclusion, including the CBDC access and use by the unserved and underserved populations, the improvement of the quantity and quality of (new) financial products and services for such populations;
    - The management of different relationships (the rights and obligations of the central bank, commercial banks, third-party service suppliers such as vendors);
    - The efficiency of the risk management plan, such as the short-term and long-term response to challenges and risks (fake or defective CBDC, economic risks);
    - The learning arrangements to handle evolving technology and practices, including the capacity to understand the broader implications of CBDCs (such as unintended effects including the hesitation to adopt CBDC by users due to the restriction on its use) and the arrangements to avoid unintentional or inadvertent exclusion;
    - The CBDC exit plan if needed.

As with stage 2, this stage can also embed the UN Principles for Responsible Digital Payments as a framework of reference.

BOX 3: CBDCS FOR DEVELOPMENT OUTCOMES

Beyond conventional use cases such as retail payments and taxation, CBDCs have significant potential to advance development outcomes, particularly in the areas of social protection, humanitarian assistance, and climate resilience. Their programmability, transparency, and traceability make them a compelling tool for disbursing Government-to-Person (G2P) payments and aid with greater efficiency and accountability.

For instance, programmable CBDCs could be used to disburse social protection payments—such as child benefits, pensions, or emergency income support—with built-in conditionalities and expiration dates to encourage timely use. In climate-vulnerable countries, CBDCs could enhance disaster response by enabling faster, more targeted payouts after floods or cyclones, building on mobile money models already in use (for example, in Bangladesh, cash transfers after floods have used mobile payments for disaster response). Similarly, humanitarian actors such as the World Food Programme have tested blockchain-based systems to deliver aid in Lebanon; CBDCs could further support real-time, rules-based disbursements with improved data integrity and user protection.

Integrating these use cases into CBDC design helps align central bank digital currencies with SDG-linked social investments, making them not just financial infrastructure but tools for equitable, climate-smart development. Of course, this would also involve the discussion of the role of central banks in this regard.

TIPS FOR STAKEHOLDER ENGAGEMENT DURING STAGE 3

- Depth of stakeholder engagement, including the engagement with the industry such as market consultation (e.g. a stakeholder questionnaire) to assess commercial feasibility
- Adjust the scope of stakeholders if needed (e.g. new stakeholders due to new use cases)
- Update materials about CBDC to engage with stakeholders
- Narrow the gap between different positions and seek solutions
- Seek feedback on the designs (including solutions to unintended effects)

4 STAGE 4: CBDC PILOT

The adoption of an innovation such as a CBDC is affected by a variety of factors, like its relative advantage, for example *Is the innovation perceived as superior to the current practices?* Most of these factors can be addressed during the design phase outlined above. One other key attribute of an innovation that affects its adoption[1] is trialability. Trialability refers to the extent to which an innovation can be tested. In the context of CBDCs, trialability involves the comprehensive test of use cases (such as offline payments, which are useful for users lacking internet access), assumptions, safety, and user feedback to refine CBDCs. Taking safety as an example, a reporting mechanism for problematic attempts and threats could be tested. Trialability can be conducted in various ways, from pilots to sandboxes. Pilots may determine if advanced phones are necessary for CBDC applications or if offline CBDC payments can be facilitated on feature phones. Pilots can further test existing infrastructure (e.g. telecommunication connectivity such as internet access) and new infrastructure (e.g. potential cloud-based infrastructure that supports CBDCs) to see if a seamless user experience is ensured. Before and during pilots, sandboxes can serve as controlled environments to explore various crucial aspects, including the development of CBDC technologies, testing of specific use cases, and identification of risk mitigation measures (such as privacy protection mechanisms) to mitigate technological, financial, and other risks. To promote cooperation and save costs of national sandboxes on similar issues, regional sandboxes can be explored, and they shall consider different national regulations and practices.

The steps below inform how to implement a CBDC pilot:

- ❑ Test the whole CBDC team (e.g. technology, finance, security, law).
- ❑ Further test the regulatory, technology and governance arrangements.
- ❑ Further test the CBDC adoption rate (e.g. the acceptance of CBDC payments by merchants) and other factors relating to financial inclusion (e.g. cost recovery of CBDC use cases).
- ❑ Further test risk management plans (e.g. fast incident response and recovery, long-term solutions) and the resiliency of “hardware” and “software”.
- ❑ Conduct literacy programs and test their effect.

TIPS FOR STAKEHOLDER ENGAGEMENT DURING STAGE 4

- Establish a robust and evolving stakeholder engagement mechanism
- Collect and review the reasons why stakeholders are not interested in CBDC use
- Confirm the commitments and readiness of stakeholders, including those of commercial banks, telecommunication companies, and technology firms
- Collect the feedback of participants
- Test ways to handle uncertainties and unexpected effects, including continuous risk identification and mitigation arrangements (e.g. cyber-attacks, natural disasters, financial crisis and bank run, support teams that operate 24/7/365), worst-case scenario and responses (e.g. a possible exit plan)

[1] Everett M. Rogers, Diffusion of Innovations, Fifth edition (Free Press. 2003), pp. 138-158.

5 STAGE 5: CBDC IMPLEMENTATION (ISSUING A LIVE CBDC, AND POST-IMPLEMENTATION)

This final stage marks the transition to issuing a live CBDC, supported by a fully operational ecosystem. Post-implementation efforts focus on capacity building, ongoing literacy programs, and fostering innovation through new use cases. Continuous monitoring and feedback loops ensure that the CBDC system remains adaptable to emerging challenges and opportunities. This phase emphasizes collaboration at regional and multilateral levels to align the CBDC's evolution with global trends and best practices.

The following steps guide the CBDC implementation stage:

- ❑ Strengthen the complete team (e.g. strengthening the team on foresight and future scanning).
- ❑ Implement the regulatory, technological and governance arrangements, including ensuring regulatory compliance.
- ❑ Continue building capacity of stakeholders (via training) and exploring new use cases, including collaboration at regional and multilateral levels.
- ❑ Continue the delivery of digital and financial literacy programs and build users' trust. It is recommended to embed literacy modules in CBDC apps (such as audio/video explainers) and ensure recourse is easy and accessible (such as hotline integration or chatbot-based complaints[2]).
- ❑ Monitor the CBDC use (e.g. response to incidents) and resource allocation.
- ❑ Develop the CBDC ecosystem (e.g. sustainable CBDC use cases and business models)
- ❑ Seek feedback and upgrade the system.
- ❑ Pay close attention to regulatory, technological and governance development (e.g. the practice of crypto) to revisit assumptions/questions and improve the CBDC system.
- ❑ Predict future risks and seek solutions to challenges and uncertainties.

TIPS FOR STAKEHOLDER ENGAGEMENT DURING STAGE 5

- Continuously review and improve the stakeholder arrangement, which may serve as a decision-support mechanism to provide knowledge and promote foresight (e.g. long-term system development, ways to understand and handle costs such as R&D and energy consumption)
- Engage with stakeholders such as during the operation and incidents
- Engage with stakeholders to explore the future trend, challenges and solutions associated with CBDC

[2] The BTCA technical note 'Make Recourse Clear, Quick, and Responsive' offers concrete guidance for complaint mechanisms that could be cited here.

Charting the path forward for CBDC implementation

As digital economies expand and the demand for accessible, inclusive financial solutions grows, central bank digital currencies present an unprecedented opportunity to reshape the financial landscape. This publication has provided a comprehensive methodology for the design, testing, and implementation of CBDCs, grounded in the principles of financial inclusion, technological resilience, and regulatory integrity.

Each stage of the methodology—from understanding financial inclusion barriers to CBDC implementation—emphasizes a user-centric approach that prioritizes the needs of the unserved and underserved. By aligning CBDC design with the unique challenges faced by various populations, countries can reap the benefits of this innovative tool to close financial inclusion gaps and drive sustainable development.

Critical to the success of CBDCs is the ability to address foundational challenges, such as digital and financial literacy, infrastructure gaps, and the need for robust technology, regulation and governance arrangements such as privacy protections and cyber security mechanisms. Stakeholder collaboration across public and private sectors plays a pivotal role in ensuring that CBDC systems are scalable, adaptable, and aligned with global trends. Equally important is the commitment to continuous learning, where lessons from pilots and early implementations and other practices (e.g. crypto) inform iterative improvements to the CBDC ecosystem.

Looking ahead, the road to CBDC adoption will not be without challenges. However, with clear methodologies, coordinated efforts, and a focus on inclusivity, central banks can lead transformative changes that extend beyond financial systems to drive broader economic and social progress. As this publication outlines, the journey towards CBDC implementation is as much about technology as it is about fostering trust, addressing inequalities, and building a resilient digital future. Through thoughtful planning and execution, CBDCs can become a cornerstone of inclusive growth, enabling individuals and businesses to access the tools and opportunities they need to thrive in the modern economy.

Annexes

ANNEX 1 – IDENTIFYING BARRIERS TO FINANCIAL INCLUSION

Barriers to financial inclusion often arise from a combination of structural, technological, and policy related factors. Countries must address several key questions to understand the root causes of exclusion: for example, *is there adequate mobile and internet coverage in remote areas? Are there legal obstacles preventing certain populations from accessing financial services? Are costs of traditional financial services prohibitive for low-income individuals? Is there any issue concerning digital and financial literacy?* These barriers will differ by country, and any CBDC implementation must account for these realities.

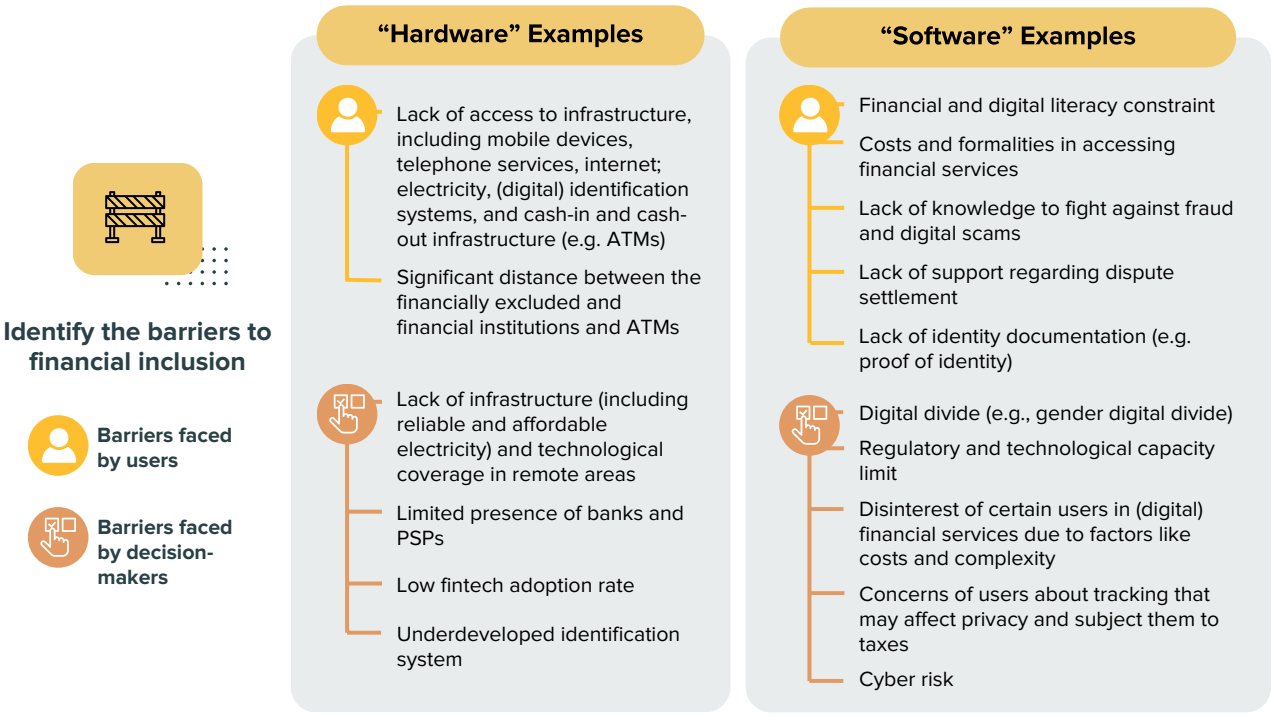
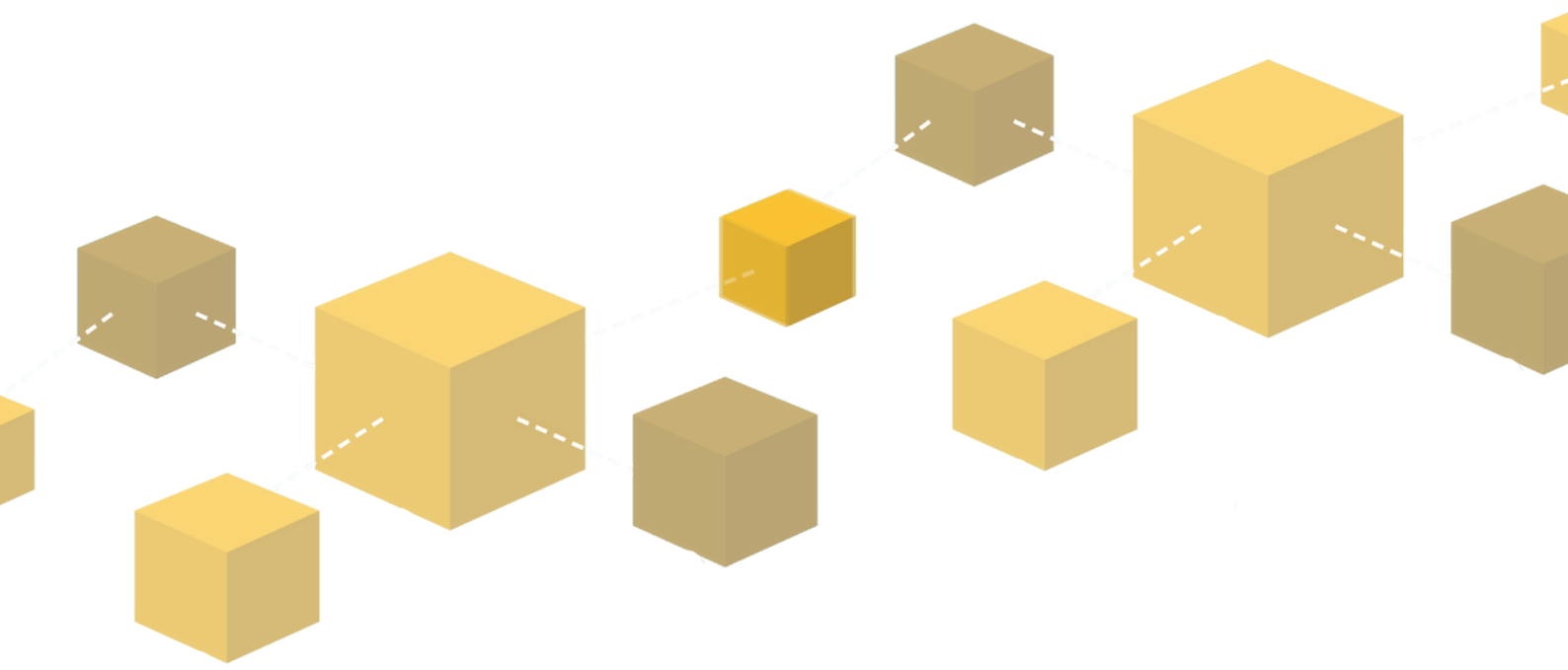


Figure 3. Barriers to financial inclusion

A comprehensive understanding of the barriers will guide central banks in determining whether CBDCs can truly address financial inclusion or if complementary policies are needed, such as investing in digital infrastructure, providing financial education, or revising outdated regulatory frameworks. From a development perspective, addressing barriers such as digital and financial illiteracy, poor infrastructure, and regulatory gaps should be seen as an opportunity for capacity-building and institutional strengthening. Policies targeting the digital divide, particularly for women and marginalized groups, should be aligned with CBDC rollouts. The deployment of CBDCs could also spur investment in local digital infrastructure, which would benefit other sectors like healthcare and education, further enhancing development outcomes. The barriers to financial inclusion, as indicated in Figure 3, involve “hardware” (e.g. digital connectivity) and “software” (e.g. financial and digital literacy) barriers. Users and decision-makers, particularly central banks, would face barriers that affect access to and usage of financial services at an affordable price, and there is some overlap between these barriers.

Based on new technologies, CBDCs create the opportunities to possibly lower access and price barriers faced by financial inclusion. These opportunities include low or no fees regarding CBDC usage, no bank account needed for opening certain CBDC wallets, new functions of CBDCs (e.g. offline use, smart contracts), and possibly simplified identification requirements for low-risk transactions. With users' consent, CBDCs could offer valuable data like transaction records to promote the access to financial services (e.g. loans), but privacy protection must be handled with care.



ANNEX 2 – RISKS

Categories	Examples	Mitigation
Adoption-related risks	• Inadequate or unreliable infrastructure (e.g. electricity, internet, telecommunications) • Digital divide • Concerns over surveillance • Lack of a sustainable business model	• Investments in infrastructure and its accessibility • Low-tech options and offline functions • Programs to improve digital and financial literacy • Privacy protection and remedies through regulatory and technological arrangements • Transparency of data collection, use, management, and removal if any • User-friendly interfaces (e.g. applications) and frequently asked questions of CBDC • Test commercial viability and cost recovery before the implementation • Other measures such as merchant onboarding arrangements and incentives
Operational and technology risks	• Security vulnerabilities (e.g. cyberattacks, fraud), system failures, and scalability risks during peak usage periods • Risks of offline payment (e.g. double spending) • Unclear dispute settlement system • Management risks (e.g. poor coordination among agencies)	• Carefully design, test and upgrade operation/technology system, including cyber security related mechanisms and infrastructure, and security measures for offline functions (e.g. transaction limits) • Efficient dispute settlement processes • An CBDC exit plan that will be considered if needed
Economic risks	• Potential bank runs and financial disintermediation that affect credit availability • Other impact on monetary policy implementation • The impact on the foreign exchange and capital outflows	• Limits on CBDC holding • Other regulatory and technological arrangements, including the coordination between CBDCs and other policies
Regulatory and compliance risks	• Money laundering and terrorist financing • Data misuse, leakage and unauthorized data dissemination • People without proper identification document unable to access CBDC due to stringent KYC processes • Lack of enforcement capacity • Competition issues concerning the relationship with existing payment service/platforms • Lack of interoperability with other financial systems	• Reduced KYC requirements for low-risk transactions • Regulation and governance of data • Tiered KYC system (lower KYC requirements for small transactions) and new digital identity system if possible • Regulation and governance to promote fair competition (including the access to data with user consent) • Technological and regulatory arrangements to ensure interoperability and inclusiveness (e.g. digital ID solutions)
Other risks	• Unsatisfactory performance of CBDC system • E-waste and energy consumption	• Build trust by transparent processes (e.g. communication of CBDC performance) and proactive stakeholder engagement • Other governance, regulatory and technological arrangements, such as tendering requirements for resource-efficient technologies and promoting sustainable hardware lifecycle management

ANNEX 3 – MULTI-FACETED ASSESSMENT EXAMPLES

The table below illustrates selected examples of aspects that will need to be taken into consideration while performing a country assessment. First, regulatory and governance arrangements are crucial to handle risks. These carefully-designed arrangements shall be aligned and effectively implemented, therefore an assessment of joint efforts of public and private actors is required. Second, technological readiness helps to develop resilient technology and facilitate user access and usage. A prime example is the design of easily accessible hardware-based and/or software-based wallets, including the distribution and other services (e.g. repair and replacement) of hardware-based wallets. CBDCs also requires a system to understand its operation, a cybersecurity intelligence system, and a disruption (e.g. service outages) response and recovery system. Third, sustainable business models are important to recover costs. Although usage of CBDCs would likely incur low or no fees for users to encourage widespread adoption, continuous investment is still needed. Such investments include hardware and software upgrades to meet user needs such as convenience and cyber security, education of users regarding key issues such as cyber risks and fraud mitigation, merchant training, and communication to raise public awareness.

	Examples
Regulatory and governance arrangements	• The integration and coordination of policies (e.g. privacy, financial stability, cyber security, financial inclusion, the digitalization of the economy) • The potential rule development such as privacy protection, data access, consumer protection, outsourcing, dispute settlement, risk management of new CBDC service suppliers (e.g. telecommunication operators, and technology firms) • Internal controls of stakeholders (e.g. PSPs) • Environmental implications (e.g. energy consumption, e-waste) • CBDC exit plan (in case such exit is needed)
Technological readiness	• Technological readiness of central banks and regulators, such as digital readiness concerning cyber security • Expertise to design, implement, and develop CBDCs, including sustainable use cases, and technological capacities for CBDC accessible 24/7/365 in situations such as cyberattacks and natural disasters • The extent of the reliance of central banks and regulators on vendors (e.g. third- party developers and other firms) • Technological readiness of other stakeholders (e.g. commercial banks, PSPs, merchants)
Costs	• Costs for “hardware” and “software” (e.g. sufficient technological infrastructure in a country with dispersed geography, a resilient system accessible 24/7/365, project sandboxes and pilots, evolving financial and digital capability projects, contingency planning and crisis preparedness), including capital expenditure, operational costs, and other costs • Revenues and other funding support if any • Sustainability of cost recovery

ANNEX 4 – LIST OF RESOURCES

1. André Reslow, et al., *Cross-Border Payments with Retail Central Bank Digital Currencies: Design and Policy Considerations*, IMF FINTECH NOTE 2024/002 (2024).

2. Digital Financial Services Working Group, *Central Bank Digital Currency – An Opportunity for Financial Inclusion in Developing and Emerging Economies?* 1-65 (2022).

3. Raphael Auer, et al., *Central Bank Digital Currencies: A New Tool in the Financial Inclusion Toolkit?*, FSI INSIGHTS ON POLICY IMPLEMENTATION NO 41 1-36 (2022).

4. Ashley Lannquist & Brandon Tan, *Central Bank Digital Currency's Role in Promoting Financial Inclusion*, IMF FINTECH NOTES NO 2023/011, 1-33 (2023).

5. Anton N. Didenko & Ross P. Buckley, *Central Bank Digital Currencies: A Potential Response to the Financial Inclusion Challenges of the Pacific-Risks and Opportunities*, 3 ISSUES IN PACIFIC DEVELOPMENT 1-40 (2021).

6. Gabriel Soderberg, et al., *How Should Central Banks Explore Central Bank Digital Currency? A Dynamic Decision-Making Framework*, IMF FINTECH NOTE 2023/008, 1-40 (2023).

7. Raúl Morales-Resendiz, et al., *Implementing a Retail CBDC: Lessons Learned and Key Insights*, 2 LATIN AMERICAN JOURNAL OF CENTRAL BANKING 1-10 (2021).

8. Neha Narula, et al., *CBDC: Expanding Financial Inclusion or Deepening the Divide?*, (2023), https://www.dci.mit.edu/projects/cbdc-expanding-financial-inclusion-or-deepening-the-divide

9. Nana Yaa Boakye-Adjei, et al., *Can Central Bank Digital Currencies Help Advance Financial Inclusion?*, 17 JOURNAL OF PAYMENTS STRATEGY & SYSTEMS 433-447 (2023).

10. Brandon Joel Tan, *Central Bank Digital Currency and Financial Inclusion*, IMF WORKING PAPERS WP/23/69 1-53 (2023).

11. Nikhil Raghuveera, *Central Bank Digital Currency Can Contribute to Financial Inclusion but Cannot Solve Its Root Causes* (2020),https://www.atlanticcouncil.org/blogs/geotech-cues/central-bank-digital-currency-can-contribute-to-financial-inclusion-but-cannot-solve-its-root-causes/

12. BIS Innovation Hub, *Project Polaris (Part 1: A Handbook for Offline Payments with CBDC)*, 1-118 (2023).

13. BIS Innovation Hub, *Project Polaris (Part 2: A Security and Resilience Framework for CBDC Systems)*, 1-67 (2023).

14. Jonathan Lee, et al., *Project Polaris (Part 3: Closing the CBDC Cyber Threat Modelling Gaps)*, 1-51 (2023).

15. Heng Wang, *Achieving Financial Inclusion Through Digital Currencies* (2024), https://go.undp.org/cbdcfi1

16. Heng Wang, *How Can CBDCs Be Designed to Drive Financial Inclusion?* (2024), https://go.undp.org/cbdcfi2

17. Heng Wang, *A Practical Guide to Driving Financial Inclusion Through CBDCs* (2024), available at https://go.undp.org/cbdcfi3