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# CENTRAL BANK DIGITAL CURRENCY AS AN INSTRUMENT FOR GREEN BANKING: PROBING THE ROLE OF CBDCs IN PROMOTING GREEN BANKING

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Ananya, B.A.LL.B. (H.), Department of Law, Quantum University, Roorkee

## ABSTRACT

There has been a significant ‘Paradigm Shift’ at the global stage, with majorly all the global actors recognizing the need of and acting towards achieving Sustainability in all the possible spheres and by taking relative steps and measures. Banking is also one of those spheres or areas. Green Banking has emerged as a significant tool for promoting sustainable finance and now the current scenario is witnessing the emerging role of Central Bank Digital Currencies (CBDCs) in Green Banking. Both the Green Banking and CBDCs have an interrelated dynamics or relationship. Leading towards Sustainable Development and for the accomplishment of Sustainable Development Goals (SDGs), specifically SDG 12 (Responsible Consumption and Production), SDG 13(Climate Action) and SDG 7(Affordable and Clean Energy) which are related to the concepts of green finance and promoting sustainable banking practices, CBDCs play a very significant role. This study provides an insight into the role CBDCs play in promoting Green Banking.

**Keywords:** Sustainability, Sustainable Development, Sustainable Development Goals (SDGs), Green Banking, Digital Transactions, Central Bank Digital Currency (CBDC), Bank for International Settlements (BIS), International Monetary Fund (IMF), e-Rupee.

## 1. INTRODUCTION AND CONCEPTUAL FRAMEWORK-

### 1.1 Background-

*“Over 266.2 billion real-time payment digital transactions have been recorded globally in 2023, equivalent to a growth of 42.2% on YoY (Year-over-Year) basis<sup>1</sup>. Moreover, the number of global payments made using Central Bank Digital Currencies (CBDCs) will reach 7.8 billion in 2031, up from 307.1 million in 2024, showing a remarkable increase by 2,430 %, supporting and driven by the Central Banks<sup>2</sup>. Have you ever wondered why the conventional banking practices are changing and aligning with new emerging trends and technologies?”*

The whole world is now witnessing the emergence of many contemporary challenges like energy crisis, wars and conflicts, climate change and environmental degradation etc. The climate change is one of the major concerns requiring immediate action. *It refers to long term shifts in temperature and weather patterns. Such shifts can be natural, due to changes in the sun's activity or large volcanic eruptions. However, since the 1800s, human activities have been the main driver of climate change, primarily due the burning of fossil fuels like coal, oil and gas.*<sup>3</sup> The climate change has created the urgency to take possible sustainability measures to prevent and mitigate further deterioration in the climate's health.

This sensitivity has created a significant 'Paradigm Shift' at the global stage, with majorly all the Global actors recognizing the need of and acting towards achieving Sustainability in all the possible spheres, by taking relative steps and measures. From manufacturing sector to the tertiary service sector, there is a shift from conventional working practices to sustainable practices, to mitigate the climate change. Banking is also one of those spheres or areas and guided by the same motive, the global financial ecosystem is increasingly aligning with sustainability goals.

The increasing urgency of climate change has made financial institutions to espouse environmentally responsible practices under the concept of green banking. *Green Banking refers to the various efforts or measures taken by the banks to promote sustainability and*

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<sup>1</sup> Global Real-Time Payments Growth “Sustainable” As New Use Cases Push Transactions to Record, ACI Worldwide Report on (April 30, 2024), <https://investor.aciworldwide.com/node/24976/pdf>.

<sup>2</sup> Lorien Carter, *CBDC Transaction Volume to Reach 7.8 Billion by 2031*, (Oct. 28, 2024), <https://www.juniperresearch.com/press/cbdc-transaction-volume-to-reach-78-billion-by-2031/>.

<sup>3</sup> <https://www.un.org/en/climatechange/what-is-climate-change>.

*environment-friendly practices in their operations.*<sup>4</sup> Green Banking encourages and promotes sustainable financial practices such as reducing paper-based transactions, promoting environment-friendly investments and supporting green finance initiatives. These practices involve prioritizing environmental protection balancing it with long-term profitability, offers products like green loans, green bonds, financing the renewable energy projects and reducing the carbon footprints through digital, paperless transactions. It works aligning and complying with the ESG (environmental, social, governance) principles, using environmental, social and governance factors for evaluation, management and mitigating the risks in lending and investment portfolios.

Nations worldwide have recognized the significance of sustainable finance and have taken out various distinct policies and measures to encourage green banking. For example, the European Union has introduced its EU Sustainable Financial Action Plan (European Commission, 2018)<sup>5</sup>, similarly in India, the Reserve Bank of India (RBI) published a Framework for Acceptance of Green Deposits (in 2023), and China integrating green finance into its economic strategy (Zhang et al, 2017) etc. All these measures signify the increasing awareness and actions taken towards sustainability at the global level.

Also in recent years, Central Bank Digital Currencies (CBDCs) have evolved as a significant novelty and transformation in the global finance system. CBDCs are the digital form of sovereign currency issued by the central bank of any nation. *It is a new form of fiat currency that only exists in digital form, reduces printing money and facilitates digital transactions by simplifying them.*<sup>6</sup> These are the digital fiat money and are government-backed, offering high security and trust. Many countries have introduced their own digital fiat currencies or CBDCs, for instance- Bahama's Sand Dollar, China's Digital Yuan (e-CNY), Nigeria's eNaira, etc., with Bahama's Sand Dollar becoming the first and fully launched operational CBDC. India also introduced the digital Rupee (e ₹), its own Central Bank Digital Currency in 2022, through pilot projects by the Reserve Bank of India (RBI) for both wholesale and retail transactions.

CBDCs can potentially support Green Banking initiatives by enabling fully digital transactions, reducing reliance on physical currency, lowering down the operational costs and by directing

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<sup>4</sup> Dr. Jay Desai & MS Janki Prajapati, *Green Banking and Sustainable Finance: Global Trends, Indian Practices, and Future Prospects*, 7 GAP Bodhi Taru 34 (2024), <https://www.gapbodhitaru.org/>.

<sup>5</sup> *Id.* at 34.

<sup>6</sup> *Central Bank Digital Currency*, European Data Protection Supervisor (May 13, 2026), [https://www.edps.europa.eu/press-publications/publications/techsonar/central-bank-digital-currency\\_en](https://www.edps.europa.eu/press-publications/publications/techsonar/central-bank-digital-currency_en).

and facilitating programmable financial flows for green investments or in initiatives having a green focus. Green Banking and CBDC together can contribute towards achieving sustainability and the Sustainable Development Goals specifically SDG 7 (Affordable and Clean Energy) by financing the non- conventional renewable energy projects, securing access to clean energy (UNEP FI 2020); SDG 9 (Industry, Innovation and Infrastructure), encouraging sustainable industrial growth by fostering environment- friendly innovations<sup>7</sup>; and SDG 13 (Climate Action) by incorporating financial risk investment into their decisions in order to align with global climate objectives (UNFCCC 2015).

The existing studies and literature explore various dimensions and aspects of Green Banking and CBDCs separately, providing a rich knowledge and insights about both these concepts and their relevant potential aspects like- Green Banking and sustainable performance in developing economy<sup>8</sup>, effects of such initiatives on various sectors,<sup>9</sup> with the studies on green banking related to effects of such initiatives on various sectors, performance in developing economies etc., and sustainability of digital transactions, issues related to CBDCs and various perspectives on the same .

However, the present study distinguishingly combines both these significant concepts or fields and contribute significantly by analyzing the role of CBDCs as a tool or instrument for promoting Green Banking, and the relationship between these both.

The following sections highlight the research objectives, the questions it tries to answer, the methodology used for the study and discuss the role of CBDCs in Green Banking.

## **1.2 Research Objectives-**

The main objective of this paper is to elaborately comprehend the relationship between the Central Bank Digital Currencies and Green Banking, particularly involving an emphasis on the following:

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<sup>7</sup> European Comm'n, Action Plan: *Financing Sustainable Growth*, COM (2018) 97 final (Mar. 8, 2018), <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0097>.

<sup>8</sup>Md. Abu Issa Gazi, Abdullah Al Masud, Liton Bhushan Howlader, Abdul Rahman Bin S Senathirajah, Md. Sabbir Howlader, Mohammad Bin Amin, Afaf Ahmed, Salem Hamad Aldawsari & Veronika Fenves, *Green Banking and Sustainable Performance in Developing Economy: Exploring the Mediating Role of Green Brand Image and Green Banking Policy with the Moderating Effect of Green CSR*, 7 J. Sustainability Rsch., no. 4, (2025), at 1, [https://sustainability.hapres.com/htmls/JSR\\_1824\\_Detail.html](https://sustainability.hapres.com/htmls/JSR_1824_Detail.html).

<sup>9</sup> *Asian Journal of Management*, (May 13, 2026), <https://ajmjournal.com/AbstractView.aspx?PID=2024-15-3-7>.

- This study aims to understand the emerging role of CBDCs in promoting Green Banking practices;
- The study also aims at exploring the relationship between Green Banking and CBDCs;
- It also aims at examining how CBDCs lead to sustainability and promote SDGs;
- Recommending any suggestions or policy measures.

### ***1.3 Research Questions-***

Driven by the study's objectives, the following questions are raised and presented as follows:

- What is the relationship between Green Banking and CBDCs?
- How do CBDCs promote Green Banking practices and sustainability goals?
- What can be the possible measures to promote CBDCs to achieve sustainability?

These questions are addressed and resolved in the following sections, helping in having deep insights into the present study and achieving its goals or objectives.

### ***1.4 Research Methodology-***

The research methodology adopted for this study is the *Qualitative Approach* supported by the *Documentary Analysis* to derive the data, findings and results. The present study is done and primarily based on secondary sources of data such as academic journals, articles, research papers, books and other sources like official government reports. The Qualitative methods enable in depth exploration of the various concepts and patterns within the research context while the Documentary Analysis is used to systematically review and interpret the materials, ensuring credibility and comprehensive understanding of the topic while enabling flexibility in analysis and interpretation of the findings. Therefore, this study adopts Qualitative Approach supported by the Documentary Analysis.

## **2. GLOBAL DEVELOPMENTS IN GREEN BANKING AND CBDCs-**

### ***2.1 Green Banking: Need and Evolution***

Green banking refers to the incorporation of environmental and sustainability concerns into banking functions, operations, lending, and investment decisions. Its evolution reflects a gradual switch from profit-oriented banking to eco-friendly and sustainably responsible financial intermediation. These include various measures or measures taken by the banks or the financial institutions to promote sustainability and environment conscious practices in their operations.

Almost all human activities release emissions and lead to climate change, however, the energy consumption- electricity, oil and petroleum, burning fossils fuels for various purposes, buildings and industries, etc., are the major activities deteriorating the Climate's health. *The United Nations Framework Convention on Climate Change (UNFCCC) identifies 'Triple Planetary Crisis' - climate change, pollution and biodiversity loss, the three main interlinked problems creating the urgency for long- term sustainability measures, in all the sectors.*<sup>10</sup>

The World Bank and UNEP FI, played a crucial role in forming guidelines and standards for sustainable and green finance. The development of ESG- Environmental, Social, and Governance principle in this phase provided an approach for assessing the sustainability of financial activities. Academic research and policy formations also boosted strengthening the significance of sustainable finance. Governments and regulatory bodies introduced policies to encourage environmentally friendly banking practices. The necessity of Green Banking gradually arose when the sustainability concerns rose drastically and due to the presence of a number of factors like Climate change risks, environmental degradation or deterioration through the industries and financial volatility associated with the unsustainable or unviable investments. The transition from traditional profit- centric banking, which often neglected the environmental concerns, to green banking shows a structural shift in the global finance which is shaped by the major factors like increasing environmental awareness, regulatory developments, financial innovations, and global cooperation and connectivity. *Banks, as financial intermediaries, profoundly influence industrial growth patterns and environmental outcomes, by significantly channelizing capital towards sustainable development and climate resilience, as led or observed by the United Nations Environment Programme Finance Initiative (UNEP FI).* This evolution has taken place in distinct yet interlinked phases, which were influenced by various global events or phenomena, regulatory frameworks and changing

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<sup>10</sup> <https://unfccc.int/news/what-is-the-triple-planetary-crisis>.

market patterns.

### ***Phase 1: 1990s to Early 2000s- Conceptual Emergence with Limited Awareness***

The origins of Green Banking can be traced back to the late twentieth century, specifically during 1990s, when environmental concerns began to encounter with economic and financial policymaking. The landmark event in this regard was the United Nations led 1992 Rio Earth Summit, which formally introduced the concept of Sustainable Development into the global policy discourse, emphasizing the requisite to balance economic growth with the environmental conservation. Although, the financial sector was not the priority focus initially, the summit laid the foundation for incorporating environmental or green concerns into the economic systems. Shortly after this summit, the United Nations Environment Programme Finance Initiatives (UNEP FI), were launched to engage financial institutions in the sustainability actions, marking the beginning of structured measures to align banking practices with environmental objectives.

This initial phase was largely characterized by the voluntary participation and limited awareness. The financial institutions began recognizing environmental risks; however, their response was mostly compliance driven. Banks also adopted basic environmental policies, made voluntary environment commitments and initiated small-scale sustainability programs, but these efforts were not deeply entrenched into the fundamental banking operations, since the priority was still the short- term profitability rather than the environmental concerns. Even so, this phase was a crucial period in founding the conceptual linkage between sustainability and finance, laying the springboard for more comprehensive developments in the succeeding years.

### ***Phase 2: Mid-2000s to 2015- Formal Frameworks and ESG Principles***

This second phase witnessed the emergence of formal frameworks and the gradual acceptance and incorporation of the green banking principles. During this period, the global financial system recognized that environmental risks can transform into crucial financial risks. Factors like climate change, regulatory changes and resource scarcity became probable threats to asset values and investment viability and stability and therefore, the banks began assessing such risks into their decision- making. Although these measures varied distinctively in effectiveness across countries and in scope, combinedly they contributed to the regularization of green

banking concepts. Also, in this phase financial instruments like green bonds, which aimed at channeling investments in eco- friendly and beneficial projects were developed. These innovations aligned the financial returns with environmental concerns.

### ***Phase 3: 2015 to 2020- Global Compliance and Swift Expansion driven by Paris Agreement and SDGs***

This period demonstrates a crucial turning point in the evolution of green banking, signified by rapid expansion and global alignment. The adoption of Paris Agreement in 2015 and Sustainable Development Goals (SDGs) increased the integration of sustainability into financial decisions. These frameworks presented the urgency of resolving climate change and highlighted the crucial role of finance in accomplishing sustainability targets. Consequently, the green banking evolved from just being a concept to the main financial strategy and led to increase in the scope and scale of investments in sustainable projects. Financial institutions integrated sustainability into their operations, regulatory bodies introduced more intense policies and guidelines to promote accountability, transparency, risk assessment and management in sustainable finance. The policy measures encouraging green banking increased significantly during this phase, signifying a remarkable shift in the regulatory and compliance practices.

### ***Phase 4: 2020 to Present- Aligning with Mainstream and Strategic Merger with Climate and Financial Risk***

In this ongoing phase, beginning from 2020, the green finance and green banking has come at the point of its integration and consolidation with the mainstream and with the factors like climate and financial risk. The concept of sustainability is no more seen just as an option now, it has rather become an integral component of the financial decisions of the banks. Banks are progressively embodying the assessment of potential climate threats and risks into their investment and lending operations and strategies, considering the profound impact that environmental factors can have on financial firmness and progress. The idea of “Climate risk is also Financial risk” has gained extensive global recognition and acceptance, impacting both, the marketing dynamics and regulatory frameworks in the same direction.

Technological efficiency and advancements like digital banking, data analytics, financial technology (fintech), etc., have specifically played a crucial role in the facilitation and rapid

growth of green banking practices. They help in monitoring, assessment, and reporting of environmental impacts, enhancing the credibility, feasibility and effectiveness of such measures. Awareness in public and investors has also increased, leading to the development and integration of green banking even more profoundly.

Despite all these common global developments, the evolution of green banking had been uneven and irregular across different regions of the world. Developed economies, specifically in parts of Asia and Europe, a substantial progress can be witnessed through strong institutional support and regulatory frameworks, whereas, developing countries are still in the initial phase of adoption and often face challenges like limited resource, insufficient regulatory and institutional framework, lack of expertise etc. However, these challenges do not undermine the need for sustainability and the growth of green banking, it has become a universal norm and practice.

Therefore, in essence, this evolution of banking from the traditional profit-centric banking to the prospective eco-friendly green banking practices reflects a remarkable transition in the dynamics between environment and finance. From its inception in voluntary environmental initiatives to currently being a fundamental component of the global financial system, it has undergone significant conceptual, practical, operational and regulatory developments. It continues to gain more significance with time since the increasing climate change and related issues, making its role even more critical. It not only shows a shift in the banking operations, but a restructuration and redefinition of the bank's core purpose of finance itself, which is now directed towards long-term profitability and building environment resilience and a greener, low carbon future.

## ***2.2 The Emergence and Development of Central Bank Digital Currencies (CBDCs)***

The emergence of Central Bank Digital Currencies (CBDCs) signifies a momentous transformation in the history of money or the monetary systems, reflecting the advent of technological advancements, economic transition, and the institutional progression. Described by the Bank for International Settlements (BIS) as a digital form of central bank money accessible to the public and financial institutions<sup>11</sup>, these aim to combine the efficiency of

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<sup>11</sup> Sally Chen, Tirupam Goel, Han Qui & Ilhyock Shim, Bank for International Settlements, *CBDCs in Emerging Market Economies*, Bank for Int'l Settlements, BIS Papers No. 123 (Apr. 2022), <https://www.bis.org/publ/bppdf/bispap123.htm> a40f.

digital payments with the security of the sovereign currency. From commodity- based barter system to sovereign currencies to now digital fiat money, the evolution reflects a great advancement in the financial systems. The rapid digitization in the global financial landscape due to various factors like technological advancement, efficiency, convenience, etc., has made the policymakers to consider and restructure the delivery of money itself.

#### ***A. The development of need for CBDCs-***

The need for CBDCs arose from various operational, organizational, and technical shifts in the worldwide economy. One of the major and most projecting factors has been the decline in the use of physical money and simultaneous rise of online payment platforms. As per the 2021-23 surveys of BIS, more than 90% of the central banks are dynamically researching and introducing their own CBDCs to preserve their roles in a rapidly advancing cashless economy.<sup>12</sup>

Another significant driver has been the advent of cryptocurrencies, with Bitcoin being the first one, and the consequent progress of stable coins. These innovations are best known for the highly encrypted and decentralized financial systems. However, there come many challenges with these, for instance, regulatory gaps, instability, and monetary sovereignty. Thus, the central banks sought to develop regulated digital alternatives, which are also the equivalent of the fiat currency and ensure financial steadiness and growth.

There is another key factor or motivation for introducing the CBDCs: Financial Inclusion, as emphasized by the institutions like World Bank and International Monetary Fund (IMF), as these can provide secure and affordable access to monetary or financial service to the remote and unbanked populations, especially in developing nations. Additionally, since there are insufficiencies in the cross-border transactions, the CBDCs are potentially aimed to make the cross-border payments faster, economical, and being more transparent tools for global transactions.<sup>13</sup>

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<sup>12</sup> Qifeng Tang, Central Bank Digital Currencies: *A Survey*, <https://arxiv.org/html/2507.08880v1>.

<sup>13</sup> *Estimating the Impact of Digital Money on Cross-Border Flows: Scenario Analysis Covering the Intensive Margin*, (Feb. 7, 2025), <https://www.imf.org/en/publications/fintech-notes/issues/2025/02/07/estimating-the-impact-of-digital-money-on-cross-border-flows-scenario-analysis-covering-the-561598.t>

### ***B. Evolution from Conventional Currency to CBDCs-***

The path towards CBDC can be understood through the comprehensive evolution of money from the early times till the date. The initial monetary system was based on commodity-exchange and barter system before switching to the fiat currencies issued, controlled and regulated by the governments. These fiat currency systems are stable, however rely majorly on physical cash, and on centralized and integrated banking structure.

There came the arrival of electronic or digital payments and payment systems by the late 20<sup>th</sup> and early 21<sup>st</sup> century, involving credit cards, mobile wallets and online banking. Although these innovations enhanced efficiency, they were heavily and majorly dependent on private intermediaries, shrinking the upfront presence of central bank money in day-to-day transactions.

The crucial transforming point came with the launch of cryptocurrencies, particularly Bitcoin in 2009, which are based on blockchain technology, and highlighted the viability of peer-to-peer transactions without central authority. However, lack of regulatory measures and volatility restricted their acceptance as a stable medium of exchange. These limitations led to the emergence of CBDCs, incorporating and aligning the digital advancement with sovereign support and regulatory mechanism and framework.

### ***C. Key reasons motivating the evolution-***

The technological, economic, and policy related factors, together shape the evolution of CBDCs. Advancements in digital infrastructure, Distributed Ledger Technology (DLT) and encryption have made it technologically feasible to generate protected digital currencies. Additionally, the macroeconomic concerns such as ensuring financial stability and policy considerations like maintaining monetary sovereignty, and regulatory frameworks motivate the central banks to introduce such measures and centrally controlled technologies and measures.

Moreover, the COVID-19 pandemic marked a significant turning point, fast-tracking the adoption and implementation of digital payments and encouraging the interest in cashless and contactless financial systems. Also, growing requisite for traceable, transparent transactions due to the rising illicit financial activities, reiterated the need for CBDCs.

The institutional capacity and financial development also determine the pace of adoption of

CBDCs, with advanced economies prioritizing innovation and developing economies focusing on financial inclusion. All these factors played a crucial role in the emergence and evolution of the Central Bank Digital Currencies.

#### ***D. Phases of evolution***

The CBDCs significantly evolved in distinct phases, each denoted by important indicators and milestones. All the phases reflected diverse stages of abstract and practical enrichment and development.

##### ***Phase 1: Before 2015- Conceptualization***

This phase explored whether digital money was viable. The digital transactions were potentially increasing during this period, and the potential of digital money along with assessing the need of physical cash were examined. The conceptual catalyst originated back *in 1993 with Finland's Avant Smart Card, which was an electronic cash system. Though it was withdrawn in early 2000s, it is considered to be the world's first CBDC.*<sup>14</sup> In 2009, the Bitcoin was launched by Satoshi Nakamoto, marking a significant point in the history of digital money and transactions, motivating the exploration in Central Bank Digital Currencies as more stable and sovereign option for digital transactions. Early academic and policy examinations probed into the digital currency; however, no major projects were taken out. The Bank of England also proposed CBDCs in its research agenda for 2015. This phase significantly laid down the conceptual foundation for the CBDCs.

##### ***Phase 2: From around 2015 to 2019- Research and Exploration***

Following the rapid rise of Bitcoin, central banks began to take formal steps. Central banks started to study CBDCs in response to Bitcoin and novel Fintech innovations in the field. The Bank for International Settlements (BIS) took out its first CBDC survey in 2019. During this phase, Sweden's Riksbank introduced the 'e- krona' in November 2016 and began further testing proof of concept and the validation in 2020. People's Bank of China experimented with the technical patterns, measures and advancement by 2016. *The BIS found that most of the central banks were exploring and researching CBDCs, identified the drivers, created*

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<sup>14</sup> Int'l Monetary Fund, *The Ascent of CBDCs*, Fin. & Dev. (Sept. 2022), <https://www.imf.org/en/Publications/fandd/issues/2022/09/Picture-this-The-ascent-of-CBDCs.g>

*frameworks, but only a few of them had shifted afar conceptual works.*<sup>15</sup>

### ***Phase 3: 2020 to 2022- Experimentation and Pilot Projects***

This phase witnessed the emergence and rapid rise of real-world trials, and first live launches and formal introduction of the CBDCs. There was a growth in the CBDC pilot projects in various countries. COVID-19 became a catalyst or major driver for the requisites and increase in cashless, digital payments. In October 2021, the Bahamas became the first nation to introduce and fully launch a retail CBDC, the Sand Dollar, followed by Nigeria with eNaira in October 2021. The second phase of Sweden's e-Krona included commercial banks too in its pilot project. India also launched its e-Rupee pilot project in 2022 for wholesale and retail use. By 2022, over 93% of the 86 central banks included in the survey were engaged in CBDC projects<sup>16</sup>. This phase was a landmark period in the accelerated experimentation of the CBDCs worldwide and laying springboard for the future expansion of CBDCs.

### ***Phase 4: 2022 to 2025- Global Expansion and Collaboration***

In this phase the Central banks moved beyond domestic tests to multi-national platforms. The 2023 survey of BIS showed an exponential growth in the full-fledged wholesale applications and cross-border integration and interoperability, as earlier compared to the domestic retail projects. The major cross-border wholesale projects included - mBridge by Hong Kong, China, Thailand and UAE. In October 2023, UAE endorsed and enacted the law for "National Digital Currency" and did its first cross border payment to China using Digital Dirham in 2024. International institutions like International Monetary Fund (IMF), BIS and World Bank issued guidelines for such transactions and noted that CBDCs can potentially facilitate and enhance cross-border payments. Therefore, this phase was marked by the larger expansion at the international scale with the introduction of cross-border payments with CBDCs and the efforts became collaborative, integrated and global.

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<sup>15</sup> Christian Barontini & Henry Holden, *Proceeding with Caution – A Survey on Central Bank Digital Currency*, Bank for Int'l Settlements, BIS Papers No. 101, at 1 (Jan. 2019), <https://www.bis.org/publ/bppdf/bispap101.pdf>.

<sup>16</sup> Anneke Kosse & Ilaria Mattei, *Making Headway – Results of the 2022 BIS Survey on Central Bank Digital Currencies and Crypto*, Bank for Int'l Settlements, BIS Papers No. 136 (2023), <https://www.bis.org/publ/bppdf/bispap136.pdf>.

### ***Phase 5: Emerging- Implementation and Scaling***

Finally, the phase which is currently rising, aims on the effective implementation of the fully operable CBDCs and development of regulatory frameworks. As of July 2025, 4 countries fully launched CBDCs; Bahamas, Nigeria, Jamaica and Zimbabwe. *137 nations and currency unions which represent 98% of the global GDP, are currently exploring a CBDC. 72 countries are in the advanced stage of exploration, development, and launch, as compared to only 35 countries in 2020.* The payments h made with CBDCs are rising and scaling rapidly. *China's e-CNY touched the massive transaction of 7 trillion yuan (\$986B) by June 2024 and is the largest pilot in the world, India's e-rupee being the second largest, with 10.16 billion e-rupee (\$122 million) in circulation by March 2025, which rose up to 334% from that in 2024.*<sup>17</sup> The nations are prioritizing to take a structured and comprehensive approach to pilot their CBDCs, using controlled environments to test and scale the implementation, allowing them to assess various dimensions such as technological capacity and resilience, addressing the security and privacy concerns, ensuring efficiency of and interoperability with existing financial systems. All these developments signify the large-scale integration and implementation of CBDCs globally.

### ***E. International Organizations and National Governments- The Facilitators***

All these phases are marked by distinct features and developments, playing a crucial role in the evolution of CBDCs till date and for future developments. The International Organizations and central governments have played a crucial role in sculpting and defining the global landscape of CBDCs. Organizations like the Bank for International Settlements has taken out research, surveys and significantly helped in laying the conceptual foundation for CBDCs, enabled collaborations among central banks and helped in providing and in comprehensive understanding of the trends, and policy factors related to CBDCs. The World Bank focused on financial inclusion and development impacts, the International Monetary Fund provided direction on the macroeconomic inferences, United Nations and its agencies encouraged the digital financial measures to align with the Sustainable Development Goals, indirectly promoting the adoption of CBDCs. The governments of all the countries played the most significant part and have been the primary and proactive drivers of implementation and regulation of CBDCs at their domestic and international level.

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<sup>17</sup> Atlantic Council GeoEconomics Ctr., *Central Bank Digital Currency Tracker: Key Findings* (July 2025), <https://www.atlanticcouncil.org/cbdctracker/.5>

This evolution of CBDCs demonstrate a broader transformation in the nature of money and the monetary system, motivated by factors like digitization and technological innovations, economic necessity, institutional developments and the environmental concerns. From barter exchange to traditional physical fiat currency to decentralized cryptocurrencies and digital transactions and finally to digital sovereign currency, each phase contributed to shape the modern financial landscape and ecosystem.

The continued developments, emerging implementation and scaling measures, and worldwide adoptions are likely to restructure and redefine the global finance, offering and characterized with more novel opportunities facilitating efficiency, inclusion and financial stability.

### **3. THE DYNAMICS BETWEEN GREEN BANKING AND CBDCs**

There exists a bilateral relationship between CBDCs and Green Banking. The global transition towards sustainable finance and banking has traversed with the development of CBDCs, building a synergistic relationship between an environmental measure and the monetary innovation, eventually redefining the global financial system. CBDCs, as fiat digital currencies, provide programmability, traceability and digital data-intensive transaction system that can straightway promote the green banking objectives. Contrariwise, green banking provides a policy framework or design for CBDCs to incorporate the ESG- Environmental, Social and Governance criteria. This interdependence reveals in various ways such as digitized green credit allocation and allotment, directed monetary and financial incentives for sustainable investments etc. The previous sections of the study provide an insight into what these both are and how have they emerged and evolved, the following deals with this dynamic relationship between the two. Initially, the role of CBDCs is assessed elaborately and subsequently a brief overview to the green banking's impact on CBDCs is provided.

#### ***3.1 CBDCs as a tool for promoting Green Banking***

Green Banking includes the eco-friendly banking practices which promote and encourage environment sustainability through measures like sustainable financing, low- carbon funding or investments, climate focused financial strategies, etc. The CBDCs can potentially play an efficient role in facilitating the green banking operations and promoting its objectives. However, this depends upon the sustainability of CBDCs itself, which is still a subject of consideration among researchers and scholars. The CBDC provide programmability, digital

structure, set-up and data precision which can help achieve green banking goals.

### ***A. Programmability and Directed Green Investment-***

CBDCs allow programmable currency that can imbed policy guidelines directly into the transactions. This enables central and commercial banks to automatize and systematize green investments, impose ESG- related interest rates, and channelize funds to environmental-friendly and sustainable activities. CBDCs can espouse in achieving net-zero targets. These also facilitate mechanized execution of green banking directives without depending on post-transaction checking. Instances include:

**I. ESG linked Subsidies and Interest:** Interest carrying CBDCs can apply different rates for carbon- intensive and green activities or projects. Research reveals that reciprocal evolution of green bonds and interest carrying CBDCs boost net- zero products by encouraging green bond funding and enhancing financial strategies and policy effectiveness. Adjustments in green bonds financing can be done using interest carrying CBDCs during the economic cycle which promotes decarbonization and a net- zero economy.<sup>18</sup>

**II. Conditional Allotments:** CBDCs can be programmed to provide funds only after verifying that environmental concerns are taken care of and complied. In 2023, Hong Kong used “Cash Tokens” to allot HK\$800 million, with the pilot using coupon lending directly to verified reduced emissions, thus eradicating greenwashing.

**III. Channeling Green Credit:** These can be directed to use in targeted or designated green sectors. Empirical evidence in China’s e-CNY pilots indicate that CBDCs significantly endorse green bond allotment, particularly for manufacturing and government-owned enterprises.

### ***B. Strengthening Transparency and Traceability to Reduce Green sheen***

A substantial problem in green banking is information irregularity and inadequate authentication of green or environmental claims. CBDCs, as built on DLT- Distributed Ledger Technology, generate immutable review or audit trails for financial regulations and fund flows.

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<sup>18</sup> Baogui Xin, Kai Jiang & Ernesto D.R. Santibanez Gonzalez, *The Coevolution Effect of Central Bank Digital Currency and Green Bonds on the Net-Zero Economy*, 134 Energy Econ. 107587 (2024), <https://www.sciencedirect.com/science/article/pii/S0140988324002950>.

**I. Green Bond Regulation-** Digital technologies like DLT and CBDCs can be used to check use- of- proceeds and environmental impacts regularly, as the BIS Project Genesis does by integrating green bonds and carbon markets through digital technologies that allow regulators and investors to do the verification and monitoring of the bonds.

**II. Tracking Carbon Footprint-** CBDCs can improve carbon trading and tracking by integrating transaction data with energy and emission data. The blockchain bases tracking systems facilitate rapid tracking of enterprises and their relative footprints of carbon products.

**III. Reserve Regulation-** A BIS research on green bonds observes that central banks which integrate sustainability into their asset and reserve management are achieving a ‘Quadruplet’ of their goals: safety, liquidity, return and long- term environmental sustainability.

### ***C. Monetary Policy Regulation for Climate Objectives***

**I. Risk Assessment-** CBDCs generate precise transaction data, thus enhancing the climate risk assessment. The capacity development program by IMF assists countries develop measures and tools for the better assessment of financial risks associated with climate. CBDC generated metadata can be used to train such models, thus improving their efficiency.

**II. Collateral Structure-**Programmable CBDCs can be directed for facilitating lending by the modifying collateral structure in a way which will improve the corporate ESG operation by relieving financial barriers for qualified (eco- friendly) firms. For Example: In 2018, The People’s Bank of China expanded collateral for Medium- Term Lending Facility, which enhanced corporate ESG performance by aiding financial constraints for environment friendly firms.

### ***D. Facilitate Energy System Integration and Carbon Markets:***

CBDCs can serve as the tools for energy trading and settling carbon credits, reducing settlement risk.

**I. Energy Market-** When integrated with energy systems, CBDCs could prompt energy incentives for bottom-up citizens, enable combined whole-system regulation, and encourage energy project funding, by integrating energy and emissions data with payment data, Savelli et

al. (2024)<sup>19</sup>.

**II. Carbon Trading-** The CBDCs can be used in carbon trading, being based on Distributed Ledger Technology facilitate tracking, authentication and automated financial flows which can be used in carbon trading. For example: The Bank of Korea works in conjunction with Korea Exchange for exploring CBDC and DLT in carbon market and trading.

### ***E. Reduce Environmental Trail of the Financial or Monetary System***

The conventional cash leaves a lot of environmental footprints by involving printing, storage, distribution and use of significant resources. CBDCs can potentially decrease these externalities. CBDCs can be linked with and help in achieving SDGs by reducing financial burden of physical currency, securing access to clean energy.<sup>20</sup> However, the IMF advises nations to prevent energy-intensive proof-of-concept design and to ensure that CBDCs are ecologically prioritized over existing systems. since the designs are critical and can lead to rebound effect.<sup>21</sup>

### ***3.2 Green Banking as a facilitator for CBDCs-***

Just as the CBDCs play a crucial role in encouraging green banking, the latter also influences or shape the CBDCs. They provide the framework and institutional design for sustainable CBDCs to align with the environmental, social and governance criteria for long term-sustainability concerns and for facilitating green banking objectives. Green banking frameworks require central banks to adopt and internalize climate risk in the financial operations. Green Banking primacies further motivate or encourage CBDC use cases.

### ***I. Green Banking Directives encourage Environmental Criteria in CBDC Design-***

Green banking rules need central banks to incorporate climate risk and sustainability into financial operations. This impacts CBDC design, technology options, and policy frameworks.

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<sup>19</sup> Iacopo Savelli, Cameron Hepburn & Thomas Morstyn, *A Blueprint for Energy Systems in the Era of Central Bank Digital Currencies*, 207 *Tech. Forecasting & Soc. Change* 123637 (2024), <https://doi.org/10.1016/j.techfore.2024.123637>.

<sup>20</sup>Shashank B. Singh & Gaurav Goel, *Digital Currency and Greener Environment: A Comprehensive Study of Positive and Negative Externalities of Digital Currency in India*, in *Computational Intelligence and Mathematical Applications* 317, 317 (Devendra Prasad et al. eds., 2025), [https://link.springer.com/chapter/10.1007/978-981-96-1449-3\\_24](https://link.springer.com/chapter/10.1007/978-981-96-1449-3_24).

<sup>21</sup>Int'l Monetary Fund, *Consider the Environment When Designing CBDCs*, IMF Urges, *Blockworks* (Mar. 22, 2022), <https://www.blockworks.co/news/consider-the-environment-when-designing-cbdc-imf-urges>.

As central banks act as “facilitators and key actors” in green finance<sup>22</sup>, green banking compels CBDCs to promote climate concerned finance. For example- The People’s Bank of China expounded the ‘five pillars’ of sustainable finance including green finance standardization, green finance incentive mechanism, information disclosure and supervision; which shaped the e-CNY to operate with a comprehensive green financial toolkit.<sup>23</sup>

## ***II. The Risk Frameworks of Green Banking shape Energy Use and CBDC Technology-***

Green banking mandates require climate risk assessment in financial operations. This makes central banks to avoid energy exhaustive technologies for CBDCs, thus shaping CBDC design to be of low- carbon structure. For instance- IMF guidelines explicitly ask to evade energy-intensive proof-of-concept designs and ensure that CBDCs are environmentally advanced than the current systems.<sup>24</sup> Similarly, The Network for Greening the Financial System (NGFS) conceptual framework on nature-related risks directs central banks to assess respective climate risks in economy and financial systems, thereby restraining high-emission CBDC designs.<sup>25</sup>

## ***III. Create Use Cases for Programmable CBDCs-***

By using collateral frameworks and target investing, green banking channelize capital in selective direction or projects. These create demand for CBDCs that can automate asset eligibility, security and reporting. In this manner, CBDC programmability is shaped by existing green banking mechanisms and thus creating use cases. For example: The ECB collateral framework revised its corporate sector purchase structures to include climate change concerns, leading the digital euro’s design to align or be consistent with the collateral sustainability or green objectives.<sup>26</sup>

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<sup>22</sup>Alberto Di Iorio, Anneke Kosse & Ilaria Mattei, *Embracing Diversity, Advancing Together – Results of the 2023 BIS Survey on Central Bank Digital Currencies and Crypto*, Bank for Int’l Settlements, BIS Papers No. 147 (2024), <https://www.bis.org/publ/bppdf/bispap147.pdf>.

<sup>23</sup>People’s Bank of China, *Green Finance Gets Newfound Incentivization*, State Council of the People’s Republic of China (Feb. 9, 2022), [http://english.www.gov.cn/statecouncil/ministries/202202/09/content\\_WS62036539c6d09c94e48a4e3a.html](http://english.www.gov.cn/statecouncil/ministries/202202/09/content_WS62036539c6d09c94e48a4e3a.html).

<sup>24</sup>Int’l Monetary Fund, *Consider the Environment*, *supra* note.

<sup>25</sup>Network for Greening the Fin. Sys., *NGFS Climate Scenarios for Central Banks and Supervisors – Phase IV* (Nov. 9, 2023), <https://spp.umd.edu/news/ngfs-climate-scenarios-central-banks-and-supervisors-phase-iv>.

<sup>26</sup>European Cent. Bank, *ECB Presents Action Plan to Include Climate Change Considerations in Its Monetary Policy Strategy*, ECB Press Release (July 8, 2021), [https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708\\_1~f104919225.en.html](https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708_1~f104919225.en.html).

#### ***IV. Data Disclosure Standards outline CBDC Transparency Characteristics-***

Green banking needs precise data on environmental effects and disclosure. This makes CBDCs to have enhanced traceability and reporting functions to facilitate carbon tracking, green finance monitoring and anti- greenwashing. For instance: Bank of Korea's collaboration with Korea Exchange to explore CBDC and DLT in carbon market and trading highlights the green banking's demand for carbon trading infrastructure thus shaping functionality of CBDC.<sup>27</sup>

The above factors highlight or demonstrate that the interrelationship is bidirectional, with CBDC acting as a tool for promoting green banking objects while green banking significantly shaping the CBDC design and infrastructure.

#### **4. RESEARCH FINDINGS-**

The following observations can be derived from the existing and the present study. The findings of the study are as follows:

##### ***4.1 Primary Findings- CBDCs as catalysts endorsing Green Banking***

The theoretical and empirical evidences used in the study highlight and indicate that CBDCs pro- actively promote green banking through majorly three core mechanisms, which in respective ways play a significant role in promoting and achieving green banking objectives. These core mechanisms are:

I. Programmable CBDCs enable automated enforcement of sustainable finance frameworks and environmental mandates. Interest- carrying CBDCs with differentiable interest rates for sustainable and carbon- intensive projects or activities enhance monetary framework efficiency and financing of green bonds, straightway supporting net- zero objects.

II. The infrastructure and design of 'CBDCs strengthen transparency and decreases green sheen or greenwashing. In China's e-CNY pilots, CBDC significantly encouraged the issuing of green bonds and decreased the NO<sub>x</sub>, SO<sub>2</sub>, and smoke emissions while enhancing green land

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<sup>27</sup>Soohyang Lee & Jinhee Park, *Environmental Implications of a Central Bank Digital Currency (CBDC)*, World Bank Grp. Kor. Off. Innovation & Tech. Note Series, No. 8 (July 19, 2022), <http://documents.worldbank.org/curated/en/099400407132237243>.

ratios.<sup>28</sup>

III. CBDCs significantly reduce the environmental footprint of money. The designs which do not use extensive proof-of-work systems ensure that CBDCs are environmentally better than cash and existing digital payments systems.

These findings collectively confirm that CBDCs serve and operate as multi-channel instrument for promoting and scaling green banking.

#### ***4.2 Role of International Organizations and Governments-***

International Organizations and national governments shape Green Banking- CBDC nexus through standard formulations and policy integration. The International Monetary Fund (IMF) incorporate climate-related risk into finance sector and thus clearly asks nations to promote environmentally sound CBDC designs. Similarly, Network for Greening the Financial System (NGFS) provide frameworks guiding central banks to also assess such risks while designing the CBDCs. At domestic levels, the central governments play a significant role not only by designing and implementing CBDCs but act as “facilitators” too by aligning CBDC to achieve green banking objectives.

Thus, international bodies and governments do not only regulate CBDC, they provide frameworks, guidelines and make respective efforts for the effective implementation and alignment of CBDCs and Green Banking objectives, for promoting long-term sustainability in and creating an eco-friendly financial ecosystem.

#### ***4.3 Advantages of CBDCs as tools for promoting Green Banking-***

Using CBDCs to promote green banking practices and achieving its objectives, CBDCs render certain advantages in the process:

I. Enhanced Monetary Policy- The coevolution effect between CBDCs and green bonds demonstrate that the interest rate design of CBDCs can be used for adjustments in financing the green bond during the financing cycle, thus enhancing the transmission of climate-friendly

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<sup>28</sup> Qing Yang, *The Role of CBDC in Green Finance and Sustainable Development*, <https://ideas.repec.org/a/mes/emftr/v59y2023i15p4158-4173.html>.

monetary policies.<sup>29</sup> This shows that CBDCs are not just inactive tools but dynamic instruments for decarbonization.

II. Energy System and Carbon market integration- CBDCs can be used for energy trading or for settling Carbon credits. As the collaboration of Bank of Korea and Korea Exchange for exploring CBDCs in carbon markets highlights CBDCs application in promoting green banking. This expands green banking from mere credit allocation to real- time green asset markets.

III. Information Asymmetry Reduction- As built on distributed ledgers technology, CBDCs create immutable audit trails which verify the use- of- allocations in green banking or green finance. As the BIS Project Genesis and Hong Kong's "cash token" use these technologies, and coupon payment systems which directly verify the emission reductions, thus eradicating green washing or green sheen at the foundation. This provides access to verified information for efficient or targeted allocation and carbon tracking.

#### ***4.4 Limitations or Challenges-***

Everything has pros and cons. Along with the advantages, there are certain challenges or limitations of CBDCs:

I. Environmental Impact due to Technology dependence: The environmental benefits of CBDC depend upon the design and technology. Those based on block chain technology may create rebound effect and may accentuate emissions while the conventional databases are more sustainable as compared to such technology. This is the reason IMF directly asks to ensure that CBDCs are more environmentally beneficial than existing systems.

II. Trade-off between privacy and transparency: The real-time carbon tracking entails precise transaction data, however, CBDC systems must preserve public trust through related privacy policies as ECB also emphasizes that public trust and privacy as key elements of Digital Euro. Excessive monitoring and supervision for green compliance risks undermine the CBDCs' adoption as efficient and trusted system or monetary instruments.

III. Green Conditionality and Financial Inclusion: If green restrictions are imposed by

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<sup>29</sup> Xin, Jiang & Santibanez Gonzalez, *supra* note, at 107587.

CBDCs on spending or access, exposed populations may be affected and excluded. The green banking principles must remain universal and promote financial inclusion rather than exclusion. For the same reason, Digital euro propositions contain holding limits and non-remuneration to prevent disturbing the bank deposits which are used to fund green lending, rather than directly imposing green conditions on users.

## **5. SUGGESTIONS AND POLICY IMPLICATIONS-**

The foregoing analysis indicates that CBDCs are not fully environmentally neutral innovations. Their governance frameworks, design and monetary structure directly influence the transaction system and allocation of financial resources towards sustainable and eco- friendly activities. This section integrates institutional and empirical evidences to propose some policy framework and design suggestions through which CBDCs can properly serve as the digital infrastructure and mechanism for green banking and the achievement of SDGs (Sustainable Development Goals) and SDG Agenda 2030.

### **I. Environmental Criteria Internalization in CBDC Design-**

This design principle suggests that energy efficiency must be included as a key design constraint rather than being treated as an ex-post consideration. Extensive proof-of-work consensus protocols should be avoided and Real-Time Gross Settlement (RTGS) systems and approved distributed ledger technologies should rather be adopted to minimize environmental externalities. Empirical evidence demonstrates that such designs exhibit energy consumption profiles which are equivalent to traditional card networks.<sup>30</sup> Also, infrastructure procurement should mandate cloud partners to power CBDCs with 100% renewable energy and carbon footprints should be properly disclosed, as urged by the IMF to make CBDCs environmentally beneficial.<sup>31</sup> This will make the entire CBDC system cleaner by opting low- energy or energy efficient architecture and by decarbonizing the digital infrastructure stack, thus help in attaining SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action).

### **II. Programmable CBDCs for Green Credit Allocation and Carbon Accounting-**

This design principle proposes to leverage the programmability of CBDCs to imbed climate

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<sup>30</sup> Lee & Park, *supra* note, at 1.

<sup>31</sup> Int'l Monetary Fund, Consider the Environment, *supra*.

accountability into monetary system. Using smart card tag transactions with sector wise and carbon- intensity meta data, creates tamper- resistant datasets for accounting and automated green lending authentication. This aligns with the findings of BIS that programmability can decrease barriers and inefficiencies in carbon markets.<sup>32</sup> As evident from China's CBDC pilots correlated with statistically significant increases in green bond issuance and reductions in SO<sub>2</sub>, NO<sub>x</sub>, and smoke emissions show that programmability can direct capital towards sustainable development.<sup>33</sup> This reinforces transparency in carbon markets and advances SDG 9 (Industry, Innovation and Infrastructure) and SDG 13(Climate Action) by channeling capital to clean energy.

### **III. Acclimatizing Monetary Policy Circulation: Concessional Liquidity and CBDC Remuneration-**

Central banks should use CBDCs as tools to reward green investments and penalize high - carbon activities and projects. Following the European Central Bank's decision to include climate risk into lending rules, central banks can apply the same logic to CBDCs. For instance, they could pay higher interests on CBDC balances in wallets that fund verified renewable energy, and other sustainable purposes; they could also provide low- cost CBDC loans through smart contracts only after confirming real emission cuts through IoT sensors. The People's Bank of China has already set standards for defining and tracking green finance, showing the feasibility of this approach.<sup>34</sup> This aligns monetary policy with climate goals and encouraging responsible use of green capital advancing SG 7, SDG 9 and SDG 12 (Responsible Consumption).

### **IV. Privacy- Protective Governance and Multi- Stakeholder Infrastructure-**

This design principle suggests that CBDCs must maintain user privacy while generating required data for climate action. They can use privacy- enhancing technologies to analyze CBDC transaction data, allowing assess the green loans and environmental impact without revealing the user details, as recommended by the IMF.<sup>35</sup> Along with this, CBDC architecture

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<sup>32</sup> Di Iorio et al., *supra* note, at 1.

<sup>33</sup> Yang et al., *supra* note, at 4158.

<sup>34</sup> People's Bank of China, *Green Finance*, *supra* note.

<sup>35</sup> Kieran P. Murphy et al., *Central Bank Digital Currency Data Use and Privacy Protection*, Int'l Monetary Fund, FinTech Notes No. 2024/004, at 1 (Aug. 30, 2024), <https://www.imf.org/en/Publications/fintech-notes/Issues/2024/08/30/Central-Bank-Digital-Currency-Data-Use-and-Privacy-Protection-563145>.

should be designed together by environmental departments, clean energy firms and small green businesses too, ensuring that CBDC goals align with each country's climate pledge and SDGs 7,9,12 and 13.<sup>36</sup>

## 6. CONCLUSION-

The relationship between CBDCs and green banking is dynamic and bidirectional and is analytically supported throughout the study with various evidences. CBDCs promote and encourage green banking by enabling programmable green finance, leading to transparency enhancement and reducing monetary system emissions. Government and international organization proactively define this relationship through collateral policy, by making related frameworks and guidelines, and by ensuring efficient implementation. Beyond the core finding that CBDCs play a significant role in promoting green banking, findings indicate that CBDCs can be efficient instruments for climate- aligned financial policy, information verification and integration of carbon market. However, these green benefits are conditional and depend upon factors like energy efficient designs, balanced privacy and inclusive approach, so that neither the environment nor the system has to compromise. For the same purposes, the Central Banks and governments can work on environmental internalization, programmability, adapting the monetary policy transmission and forming privacy- protective frameworks while designing CBDCs. Future developments should include quantification of emissions from CBDC system life cycles and form global standards for 'green CBDC'.

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<sup>36</sup> Singh & Goel, *supra*, at 317.

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