

# L47: CBDCs and Future Trends

## Module G: Regulation & Future

Blockchain & Cryptocurrency Course

December 2025

- Understand Central Bank Digital Currencies (CBDCs)
- Compare retail vs wholesale CBDC designs
- Analyze privacy vs surveillance tradeoffs
- Evaluate China e-CNY and Digital Euro progress
- Identify key future trends in blockchain technology
- Assess career opportunities in the blockchain space

# The Problem: How should governments regulate crypto?

## Part 3/4: CBDCs & Future

### The Challenge

As cryptocurrencies threaten monetary sovereignty and stablecoins gain adoption, central banks face a critical question: Should governments create their own digital currencies, and how can they balance innovation with control?

### Why It Matters

- Without CBDCs, private stablecoins could displace national currencies
- China's e-CNY already has 260M+ wallets, potentially challenging USD dominance

### What We Need

- Risk management and mitigation
- Understanding CBDC design choices and fundamental trade-offs (privacy vs. control)

### The Cryptoeconomics Question

*Managing systemic and idiosyncratic risks*

*Today's lesson: How CBDCs address monetary sovereignty while introducing new privacy and surveillance challenges*

**Definition:** Digital central bank money

**Key Characteristics:**

- Legal tender status
- Central bank liability
- Electronic/digital form
- May use DLT (not required)

**Not Cryptocurrency:**

Centrally issued and controlled

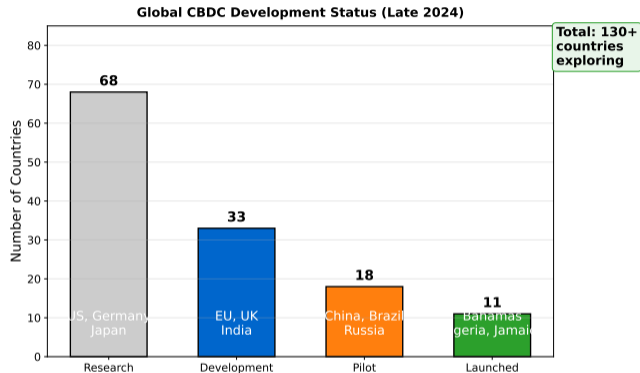
**Motivation:**

Cash decline, stablecoins, inclusion

**Status:**

130+ countries (90% global GDP)

# Global CBDC Development Status



130+ countries exploring CBDCs, representing 90% of global GDP

Aspect	Retail CBDC	Wholesale CBDC
Users	General public	Financial institutions
Use Case	Payments, store of value	Interbank settlement
Access	Widely accessible	Restricted to banks
Technology	Various (may use DLT)	Likely DLT (efficiency)
Privacy	Balance privacy vs AML	Less concern
Examples	e-CNY, Digital Euro	mBridge, Project Jasper

**Focus:** Retail CBDCs have greater societal impact and complexity

## Privacy Concerns

- Central bank sees all transactions
- Government surveillance potential
- Social credit system risks
- No cash-like anonymity

## Privacy Technologies

- Zero-knowledge proofs
- Tiered privacy (small anonymous, large KYC)

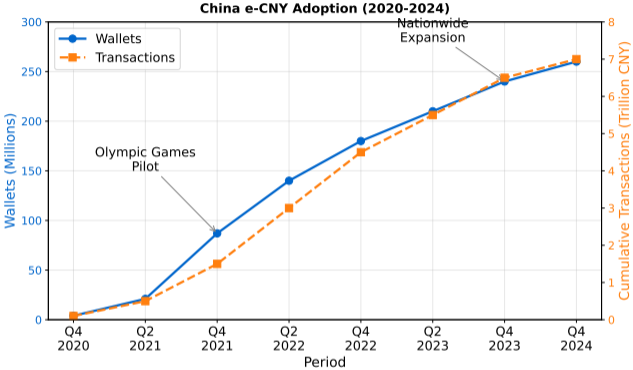
## AML/CFT Requirements

- Full anonymity enables illicit finance
- Regulatory pressure (FATF)
- Tax enforcement needs

## Design Spectrum

- **Full Surveillance:** China e-CNY
- **Balanced:** Digital Euro
- **Privacy-First:** Unlikely in practice

# China e-CNY Adoption



Largest CBDC pilot globally, 260M+ wallets by late 2024

## Architecture:

- Two-tier: PBOC + banks
- Centralized database
- Largest pilot (2020-present)

## Features:

- Dual offline payment
- Programmable (smart contracts)
- “Controllable anonymity”

## 2024 Stats:

- 260M+ wallets
- 7T+ yuan transactions

## Implications:

- Challenge USD dominance
- Surveillance concerns
- Competes with Alipay/WeChat

**Status:** Prep phase (2024-2026)

**Design Principles:**

- Privacy-focused (à e-CNY)
- Offline capability
- Free for basic use
- Banks distribute

**Privacy Model:**

- Small tx: cash-like privacy
- Large tx: full AML compliance

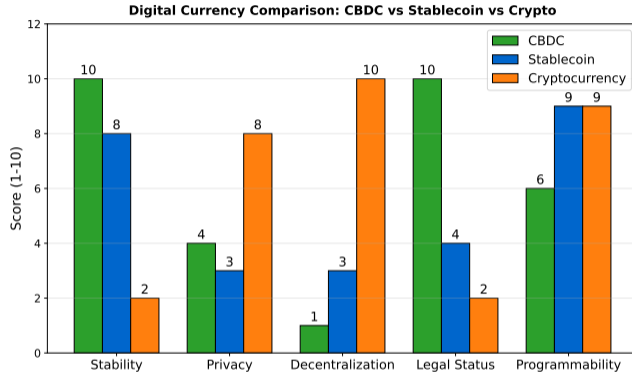
**Timeline:**

Decision late 2025, rollout 2027-2028

**Motivation:**

Monetary sovereignty, counter stablecoins

# Digital Currency Comparison



*CBDCs may crowd out stablecoins but not cryptocurrencies (different use cases)*

**mBridge:** Multi-CBDC platform

**Participants:**

China, HK, Thailand, UAE, Saudi

**Benefits vs SWIFT:**

- Instant (vs 2-5 days)
- Lower costs
- 24/7 operation

**Technology:**

Permissioned blockchain

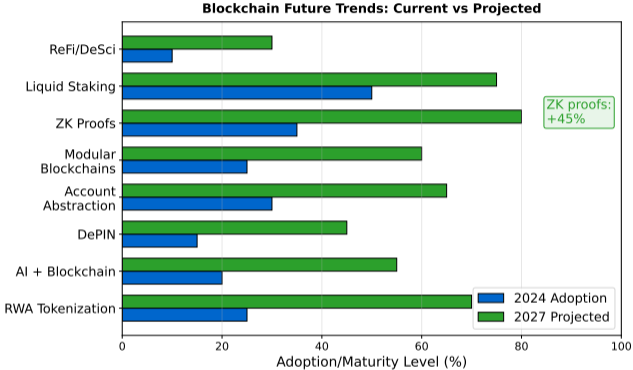
**Status:**

MVP June 2024, live transactions

**Geopolitics:**

- Bypass USD/SWIFT
- BRICS alternative system

# Future Trends: Current vs Projected



ZK proofs, liquid staking, and RWA tokenization showing strongest growth

# Trend 1: Institutional Adoption Acceleration

## 2024 Drivers:

- Bitcoin ETFs (Jan 2024)
- Ethereum ETFs (Jul 2024)
- MiCA, Swiss frameworks
- Custody: Coinbase, Fidelity

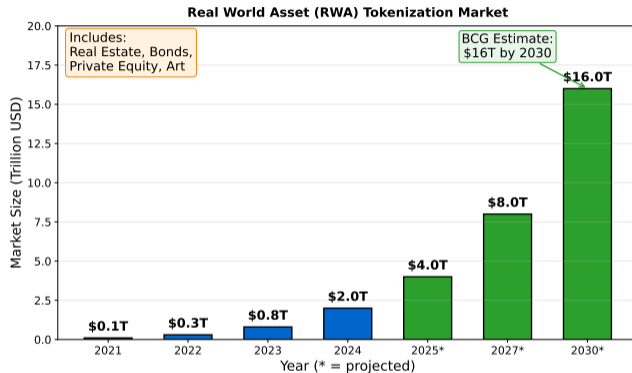
## Products:

- Tokenized securities
- Crypto lending/prime brokerage
- CME futures, options

## Impact:

\$1T+ institutional capital by 2030

# RWA Tokenization Market Growth



Real world asset tokenization projected to reach **\$16T** by 2030 (BCG estimate)

### Definition:

Representing real assets on blockchain

### Asset Classes:

- Real estate (fractional)
- Private equity, VC
- Bonds (govt, corporate)
- Commodities, carbon credits

### Advantages:

- Fractional ownership
- 24/7 trading
- Programmable compliance

### Leaders:

Centrifuge, Ondo, Securitize, tZERO

*BCG projects \$16T RWA tokenization by 2030*

### AI for Blockchain:

- Smart contract auditing
- MEV optimization
- DeFi risk modeling
- On-chain analytics

### Blockchain for AI:

- Decentralized AI training
- Verifiable AI models
- AI agent payments
- Data marketplaces

### Projects:

Fetch.ai, SingularityNET, Render, Bittensor

*Two-way synergy: AI improves blockchain, blockchain decentralizes AI*

# Trend 4: Zero-Knowledge Proofs Everywhere

## ZK Maturation:

From research to production

## Applications:

- ZK-Rollups: StarkNet, zkSync
- Privacy: Aztec, Railgun
- Identity: prove age w/o birthdate
- Compliance: private proofs

## Technology:

- ZK ASICs (faster proofs)
- Polygon zkEVM, Scroll
- SNARKs vs STARKs tradeoffs

## Impact:

Privacy + scalability without compromise

*ZK technology enables proving statements without revealing underlying data*

## Quantum Computing:

- ECDSA vulnerable (10-20 yr)
- Post-quantum migration needed

## Regulatory Fragmentation:

- Conflicting national rules
- Compliance complexity

## Centralization Creep:

- Lido: 30%+ staked ETH
- MEV/Flashbots dominance

## Systemic DeFi Risk:

- Composability = cascading failures
- Protocol interdependencies

*All risks require proactive mitigation strategies from the ecosystem*

## Technical Roles

- Smart contract developer
- Blockchain protocol engineer
- Security auditor
- ZK cryptographer

## Finance/Economics

- DeFi analyst
- Tokenomics designer
- Crypto trader/quant

**Demand:** 50,000+ open blockchain jobs, growing 30%+ annually

## Legal/Compliance

- Crypto regulatory specialist
- AML/CFT compliance officer
- Web3 lawyer

## Business/Product

- Web3 product manager
- DAO operations
- Community manager

## The Original Problem

*How should governments regulate crypto?*

## How CBDCs Address It

- **Retail CBDCs:** Provide digital cash alternative (e-CNY, Digital Euro) competing with private stablecoins
- **Wholesale CBDCs:** Enable efficient cross-border settlement (mBridge) with programmable policy tools
- **Design flexibility:** Tiered privacy models balance AML compliance with cash-like anonymity for small transactions

## Remaining Limitations

- **Privacy vs surveillance:** “Controllable anonymity” enables government tracking of all transactions (China model)
- **Bank disintermediation:** CBDCs could reduce role of commercial banks in monetary system

## Open Questions

- Will CBDCs coexist with or displace cryptocurrencies and stablecoins?
- Risk: Quantum computing threatens ECDSA signatures (10-20 year horizon)

*CBDCs provide government control over digital money but sacrifice privacy and may disrupt banking systems*

## CBDCs:

- 130+ countries (90% GDP)
- Privacy vs surveillance tradeoff
- e-CNY: 260M+ wallets
- Digital Euro: decision late 2025
- mBridge: cross-border MVP 2024

## Future Trends:

- RWA tokenization: \$16T by 2030
- ZK proofs: privacy + scalability
- AI + Blockchain synergies
- 50,000+ blockchain jobs

*CBDCs and emerging trends will reshape global finance*

- ① What are the key differences between retail and wholesale CBDCs?
- ② How should CBDCs balance privacy and AML compliance?
- ③ Why might e-CNY adoption remain limited despite government push?
- ④ Which future trend (RWA, ZK, AI+Blockchain) has most potential?
- ⑤ How might mBridge affect the global financial system?

## Quiz Questions (1–5)

**Q1. What percentage of global GDP is represented by countries exploring CBDCs as of 2024?**

- A) 50% B) 70% C) 90% D) 100%

**Answer: C** – Over 130 countries representing 90% of global GDP are exploring CBDCs.

**Q2. Which of the following is NOT a key characteristic of CBDCs?**

- A) Legal tender status B) Liability of central bank C) Must use DLT technology D) Electronic/digital form

**Answer: C** – CBDCs may use DLT but it is not required; technology choice varies by implementation.

**Q3. Who are the primary users of wholesale CBDCs?**

- A) General public B) Financial institutions C) Retail merchants D) Individual consumers

**Answer: B** – Wholesale CBDCs are restricted to financial institutions for interbank settlement.

**Q4. What is China's CBDC called?**

- A) Digital Yuan B) e-CNY C) China Coin D) PBOC Token

**Answer: B** – China's CBDC is officially called e-CNY (electronic Chinese Yuan).

**Q5. How many wallets did China's e-CNY have by late 2024?**

- A) 50M+ B) 100M+ C) 260M+ D) 500M+

**Answer: C** – e-CNY had over 260 million wallets by late 2024, the largest CBDC pilot globally.

## Quiz Questions (6–10)

**Q6. What architecture does China's e-CNY use?**

- A) Fully decentralized   B) Single-tier centralized   C) Two-tier (PBOC wholesale, banks retail)   D) Three-tier permissioned

**Answer: C** – e-CNY uses a two-tier system where PBOC handles wholesale and commercial banks handle retail distribution.

**Q7. What privacy model does e-CNY implement?**

- A) Full anonymity   B) Controllable anonymity   C) Zero knowledge proofs   D) Complete transparency

**Answer: B** – e-CNY uses “controllable anonymity” where the PBOC can see all transactions.

**Q8. When is the Digital Euro decision expected?**

- A) 2024   B) Late 2025   C) 2027   D) 2030

**Answer: B** – The Digital Euro decision is expected late 2025, with rollout planned for 2027-2028.

**Q9. How does the Digital Euro handle privacy for small transactions?**

- A) Full KYC required   B) Cash-like privacy   C) No privacy   D) Blockchain transparency

**Answer: B** – Small transactions get cash-like privacy; large transactions require full AML compliance.

**Q10. What is Project mBridge designed for?**

- A) Retail payments   B) Cross-border CBDC settlements   C) Stablecoin regulation   D) NFT trading

**Answer: B** – mBridge is a multi-CBDC platform for cross-border payments and settlements.

## Quiz Questions (11–15)

**Q11. Which countries are NOT participants in Project mBridge?**

A) China, Thailand B) UAE, Saudi Arabia C) USA, EU D) Hong Kong, Thailand

**Answer: C** – mBridge participants include China, Hong Kong, Thailand, UAE, and Saudi Arabia; not USA or EU.

**Q12. When was the mBridge MVP launched?**

A) January 2024 B) June 2024 C) December 2024 D) Not yet launched

**Answer: B** – The mBridge MVP was launched in June 2024 with live transactions completed.

**Q13. What is projected market size for RWA tokenization by 2030 according to BCG?**

A) \$1T B) \$5T C) \$16T D) \$50T

**Answer: C** – BCG estimates real world asset tokenization will reach \$16 trillion by 2030.

**Q14. Which is NOT an advantage of RWA tokenization?**

A) Fractional ownership B) 24/7 trading C) Guaranteed profits D) Programmable compliance

**Answer: C** – Tokenization offers fractional ownership, 24/7 trading, and programmable compliance, but not guaranteed profits.

**Q15. What percentage of staked ETH does Lido control, raising centralization concerns?**

A) 10%+ B) 20%+ C) 30%+ D) 50%+

**Answer: C** – Lido controls over 30% of staked ETH, creating validator concentration concerns.

## Quiz Questions (16–20)

**Q16. What cryptographic technology enables both privacy and scalability without tradeoffs?**

- A) SHA-256   B) Zero-knowledge proofs   C) RSA encryption   D) Multi-signatures

**Answer: B** – Zero-knowledge proofs enable privacy and scalability simultaneously through ZK-rollups and private transactions.

**Q17. What is the estimated timeline for quantum computing to threaten ECDSA signatures?**

- A) 2-5 years   B) 5-10 years   C) 10-20 years   D) 50+ years

**Answer: C** – ECDSA signatures face quantum computing threats in a 10-20 year timeline.

**Q18. How many open blockchain jobs exist globally with what annual growth rate?**

- A) 10,000+, 10%   B) 50,000+, 30%   C) 100,000+, 50%   D) 500,000+, 100%

**Answer: B** – There are 50,000+ open blockchain jobs with 30%+ annual growth.

**Q19. Which is NOT mentioned as an AI + Blockchain convergence use case?**

- A) Smart contract auditing   B) Decentralized AI training   C) Physical robot control   D) AI agent payments

**Answer: C** – The lesson covers smart contract auditing, decentralized AI training, and AI agent payments, but not physical robot control.

**Q20. What feature does e-CNY support that does NOT require internet connection?**

- A) International transfers   B) Dual offline payment   C) Smart contract execution   D) Real-time auditing

**Answer: B** – e-CNY supports dual offline payment capability, allowing transactions without internet connection.