
A CRITICAL ANALYSIS OF DIGITAL ASSET GOVERNANCE AND CLIMATE-CONSCIOUS FINANCIAL REGULATION IN INDIA

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ABSTRACT

The rapid expansion of digital assets has significantly transformed global financial markets while simultaneously raising concerns regarding sustainability and climate governance. As of 2025, the global cryptocurrency market exceeds USD 3 trillion, with India ranking among the world's leading adopters and accounting for over 115 million cryptocurrency users. However, the environmental impact of blockchain-based systems remains substantial, with Bitcoin mining alone consuming approximately 150–170 terawatt-hours (TWh) of electricity annually and generating carbon emissions comparable to those of several developing economies. While jurisdictions such as the European Union have begun integrating sustainability considerations into digital asset regulation through frameworks such as the Markets in Crypto-Assets (MiCA) Regulation and ESG-oriented disclosures, India's regulatory approach has largely focused on taxation and financial compliance measures, including the 30% tax on Virtual Digital Assets, the 1% TDS regime, and anti-money laundering obligations. Despite these developments, the environmental implications of digital finance remain inadequately addressed within India's evolving legal framework. This study critically examines the intersection of digital asset governance, financial regulation, and climate-conscious policymaking in India. It investigates whether the existing regulatory architecture sufficiently balances technological innovation, economic growth, and environmental sustainability, while identifying significant gaps in climate-sensitive financial oversight. The study further explores emerging international regulatory trends, ESG obligations, and sustainable finance principles to assess their relevance for India's digital economy. Given India's commitment to achieving net-zero emissions by 2070 and its ambition to become a global digital finance hub, the research contributes to the ongoing discourse on developing an integrated, sustainable, and environmentally responsible framework for digital asset governance capable of aligning financial innovation with long-term climate objectives.

Keywords: Cryptocurrency, Sustainability, Governance, Blockchain, ESG

1. INTRODUCTION

1.1 Background and Context

The rise of decentralised digital currencies is one of the biggest developments of recent financial history. At the time that the foundational Bitcoin protocol was designed and released in 2008¹ Many of the perceived skeptics labelled it as a novel concept that would not have any long-term practical use. Things turned out different thereafter. As an idea that at first meant sending and receiving money peer-to-peer, it has since developed into an entire trillion dollar financial system, with hundreds of millions of users worldwide that forced a re-thinking of monetary systems, financial intermediation and regulatory architecture.

Decentralisation is a design criterion which is the heart of cryptocurrencies. These systems operate differently from traditional centres like banks or payment processors, operating instead on networks where transactions are confirmed and logged by a decentralized group of nodes collectively, also called a blockchain². It is an unprecedented innovation in terms of immutability and transparency, it eliminates the need to trust entities, and allows cross border transactions at lower cost and transferred at unprecedented speeds.

The crypto assets market capitalisation reached USD 3.2 trillion across the globe by 2025³. However, the ecosystem is bigger than Bitcoin today, with Ethereum providing a platform for programming financial applications using smart contracts, stablecoins solving the volatility problem by backing in with traditional currencies, decentralised finance (DeFi) platforms offering a duplicate of banking services for lending, borrowing and trading, and non-fungible tokens (NFTs) altering parts of the creative economy by establishing digital property rights for digital assets. What began as a simple and impactful new financial commerce mechanism has grown into something far more complicated and important: peer to peer cash.

1.2 The Indian Context

India has a special role in the global world of cryptocurrency. The country boasts a population of 42 million young people and is home to a highly tech-savvy population segment, a large and

¹ Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System* (2008), <https://bitcoin.org/bitcoin.pdf>

² Adam Hayes, *Blockchain Explained*, Investopedia (2025), <https://www.investopedia.com/terms/b/blockchain.asp>

³ International Monetary Fund, *Global Crypto Market Report 2025* (2025)

growing population of remnants who demand both speed and simplicity in cross-border transfers, a fruitful fintech industry and a strong awareness of the inability or unwillingness of traditional financial institutions to meet their financial needs. The youthful population of over 115 million youth and a tech-savvy population is creating a demand for digital assets, alongside a significant influx of remittances—resulting in a need for fast, reliable, and cost-effective cross-border transactions—which persists when traditional financial institutions are unable or unwilling to provide them such services.

India's regulatory policies have been inconsistent. The Reserve Bank of India's circular in 2018 dealt a major blow to crypto businesses⁴ and cut them off from the formal banking system, causing significant disruptions. However, the Supreme Court had a contrary view in *Internet and Mobile Association of India v. Reserve Bank of India, 2020*⁵, and that the ban was disproportionate. The Finance Act of 2022 then further implemented a 30% tax⁶ on gains from virtual digital assets (VDA) and a 1% tax deducted at source (TDS) on “qualifying transactions” of VDA, thus recognizing their presence without providing any solid governance framework. There are significant gaps in licensing and consumer protection provisions, in the definition of securities' boundaries in securities law and in environmental accountability requirements.

The current research discourse focuses on the economic aspects, legal issues, and environmental impacts of cryptocurrency, largely ignoring how these impact one another. The argument of this paper is that this is yet another governance problem. Any structure that ignores carbon emissions and tackles taxation/fraud is missing the part of the jigsaw puzzle. If an ESG approach accommodates digital assets without considering energy usage, they are not consistent. Any tech company promising to change finance for the good, but objecting to environmental responsibility is undermining its own credibility.

The daily consumption of between 150 and 170 terawatt-hours of energy is an estimated figure for Bitcoin⁷ that is roughly in line with the total energy consumption of Argentina. Only that cannot be ruled out in serious discourse on governance for climate change. The aim of the study is thus to create a more comprehensive and executable understanding of the challenge of

⁴ Reserve Bank of India, Circular DBR.No.BP.BC.104/08.13.102/2017-18 (Apr. 6, 2018)

⁵ *Internet and Mobile Association of India v. Reserve Bank of India*, Writ Petition (Civil) No. 528 of 2018

⁶ Finance Act, No. 6 of 2022, §§ 115BBH, 194S, India Code (2022)

⁷ Cambridge Centre for Alternative Finance, *Bitcoin Electricity Consumption Index* (2025)

responsible cryptocurrency governance based on a design which integrates various facets of financial regulation, environmental law, management theory and sustainability frameworks.

2. LITERATURE REVIEW

2.1 Cryptocurrencies as Financial Innovation

As cryptocurrencies gain market traction, so too has their academic interest as tools for financial innovation. As cryptocurrencies make their presence felt in the market, so has academic interest as instruments of financial innovation also grown. Acknowledging Service Dominant Logic, the innovation is not technical, Mamuti et al. locate digital currencies in value co-creation processes⁸, converting users in crypto ecosystems from a passive receiver of financial services to a proactive value co-creator of financial services. The monetary theory aspects are also fiercely debated: Because bitcoin has a fixed supply of 21 million inflated to represent 100 million 2000% too many produce "Volatility", while this same scarcity, along with speculative trading dynamics and thin market depth, undermine its function as an everyday medium of exchange.

Cumming, Johan, and Pant take a DimOps-backed approach⁹; they list all the lost investments, stolen money and exchange failures that have occurred during the growth of this industry. The heart of their thesis is a regulatory mismatch: Systems of laws designed for deliberately located and clearly known institutions are not well suited to enforce anonymous, borderless, decentralised networks. The resulting "vulnerabilities" that may be present allow for exposure of consumers, and for bad actors to take advantage.

2.2 Blockchain and Sustainability Governance

Separate literature exists in the domain of blockchain as a way to improve visibility and transparency and apply it to sustainability. Ishibashi, Shiva and Rosenbach discover that this auditability and immutability¹⁰ Blockchain is useful in supporting environmental accountability throughout supply chains—allowing manufacturers to claim where materials come from, and certifiers to ensure environmental claims have evidence of their chain of

⁸ Cambridge Centre for Alternative Finance, *Bitcoin Electricity Consumption Index* (2025)

⁹ Douglas J. Cumming, Sofia Johan & Anoop Pant, Regulation of the Crypto-Economy: Managing Risks, Challenges, and Regulatory Uncertainty, 12 *J. Risk & Fin. Mgmt.* 126 (2019)

¹⁰ Y. Ishibashi, M. Shiva & F. Rosenbach, Sustainable and Smart: Exploring the Nexus Between Blockchain and Sustainability in Inter-Organisational Collaboration, 7 *J. Strategic Contracting & Negotiation* 149 (2024)

custody. While empirical implementation is still under way for many, the EVE framework developed by Nikolakis, John and Krishnan¹¹, with its structured conceptual lens on how blockchain can help global sustainability governance, is applicable.

2.3 ESG Considerations in Digital Asset Investment

ESG investing and cryptocurrency doings go in hand is a comparatively fresh space. In an article, Ahmad Zeb et al. expose a phenomenon of the 'compartmentalisation'¹² of investors who identify themselves as environmentally minded, but still invest in cryptos despite knowing that these carry environmental costs. Their discoveries indicate the ideas of a transformative effect of decentralised finance run side-by-side with, and not in place of, environmental awareness. Among that population, those that are most interested in POW systems are not as interested in Proof-of-Stake blockchains because they are more energy-intensive. A writer from India, Das sees a true possibility for blockchain to help with financial inclusion and transparent governance, and stresses that achieving this isn't something that happens on its own, "but will require deliberate policy actions".

2.4 Indian Scholarship and Regulatory Frameworks

The juxtaposition by Bathla and Narwal is especially relevant¹³ as it outlines measurable links between the performance of cryptocurrencies and the ESG indexes in Indian markets, which implies a growing relationship between cryptocurrencies and sustainable finance ecosystems, making it difficult to make categorical assessments of the digital market. Their work requires and advocates more explicit sustainability standards of digital assets as practical necessity for coherent portfolio management. In comparison, Zahid, Ali and Audi map out cryptocurrency governance regulation around the world¹⁴ and find remarkable differences—namely the EU's MiCA Regulation contains environmental disclosure requirements, Japan places emphasis on operational standards for exchanges, Singapore has a risk-proportionate licensing model, and

¹¹ William Nikolakis, Luke John & Harshit Krishnan, How Blockchain Can Shape Sustainable Global Value Chains: An Evidence, Verifiability, and Enforceability (EVE) Framework, 10 *Sustainability* 3926 (2018)

¹² A. Zeb et al., Sustainable Investing Meets Blockchain: ESG Attitudes and Crypto Investment Decisions, 3 *Research J. for Soc. Affs.* 453 (2025)

¹³ V. Bathla & K. P. Narwal, From Digital to Sustainable: Unveiling the Complex Interactions Between Cryptocurrencies, Traditional Markets and Sustainable Finance in India, *Int'l J. of Research & Analytical Reviews* (2024).

¹⁴ H. Zahid, A. Ali & M. Audi, Cryptocurrency Regulation and Financial Disclosure: Cross-Jurisdictional Evidence on Corporate Reporting Practices, MPRA Paper No. 127482 (2025)

the United States is bubbling with overlapping regulatory frameworks.

2.5 Identified Research Gap

The whole body of literature shows a significant void. Financial innovation scholarship focuses on efficiency and dynamics of the market. Blockchain sustainability research focuses on the potential value of blockchain rather than enacting legislative mandates. ESG investment research explores investor attitudes but does not address governance mechanisms. Focus of regulatory analyses is on financial stability and consumer protection, and very little attention to environmental accountability. This paper will contribute to this, in that it attempts to pull these strings together in an integrated model that is applicable to the Indian regulatory environment.

4. RESEARCH METHODOLOGY

This study uses doctrinal, analytical and interdisciplinary methodology as mainly secondary sources of study. The doctrinal part consists of the systematic survey of statutes, regulatory circulars, case law and international instruments. The analytical layer is conceptual analysis that uses theoretically informed approaches to represent evidence and provide normative recommendations. The interdisciplinary part brings a perspective of financial law, environmental governance, economics, management theory together, and it encompasses the inherent cross domain nature of cryptocurrency governance.

Indian and international legal texts, policy reports from Financial Stability Board, FATF and OECD, peer-reviewed academic texts and publications by various market data and industry and research organisations based on ESG and Sustainability standards, and market and energy consumption data are used as source materials. The Stakeholder Theory (1984) by Freeman fuels the governance framework¹⁵, and the EVE framework (2018) from Nikolakis et al. is a conceptual basis for the sustainability applications of blockchain.

5. ANALYSIS

5.1 Economic Implications

5.1.1 Transaction Efficiency and Cross-Border Transfers

¹⁵ R. Edward Freeman, *Strategic Management: A Stakeholder Approach* (1984)

International remittances is the most solid proof of an economic argument for cryptocurrencies. Normal corresponding banks often demand three-to five company days and payments from acquiring to the amount transferred (3 - 7 per cent). Minute blockchains settlements at a fraction of the price – a worthwhile benefit for workers sending their wages to family in developing economies.

This is directly applicable to the Indian situation. The annually remitted money to the country amounts to about USD 125 billion, and ranks the country in the top income receivers globally. Simply small amounts of cost savings on transfers would result in hundreds of millions of dollars saved in households' pockets instead of going into middlemen's pockets. In addition to remittances, programmable money – financial assets that encode conditional payment logic with smart contracts – can render current escrow, conditional payment and multi-party payment systems more efficient and require significantly less legal and administrative platform provisions.

5.1.2 Financial Inclusion Potential and Limitations

Around 1.4 billion adults worldwide are not using the formal banking system. Unlike any bank branch, cryptocurrencies don't need any paperwork or a minimum balance requirement; they just need a mobile device and Internet access. In this way, digital money can be a conceivable method for broadening monetary access.

But in the real world, those who are most comprehensively shut out of finance also confront numerous cumulative hurdles – lack of regular income, low information levels, weak technology capacity and lack of familiarity with new technology. Cryptocurrency gets around the infrastructure needed but most of the other ones are not. While it is true that financial inclusion possibility is achievable, it is important to realize that it should not be considered a given outcome of the use of blockchain, but rather an outcome that must be designed for.

5.1.3 Volatility and Systemic Risk

The volatility of cryptocurrency markets can't be matched by any traditional financial markets. Bitcoin experienced massive price drops — sometimes by more than half — followed by huge recoveries in periods of short duration. Bitcoin has seen prices drop by more than half of its cost several times, followed by recoveries, sometimes of hundreds of percent, in tight timeframes.

These types of relocations are as a result of speculation on the trading market, not enough volume of the trading market when compared to its cap, and the downside that there are no normal valuation foundations, here no cash flow, earnings, or even dividends restrict price swings in either direction.

The volatility has had a significant impact on individual retail investors who have bought at the highs and sold at the lows. Overall, the links between the prices of cryptocurrencies and traditional financial markets have increased with the rising level of institutional exposure, the growing extent of crypto lending and the widening of derivatives markets. Restrictive market corrections would generate margin calls, force sell-offs across markets and potentially pass financial woes up the chain, necessitating proactive regulatory surveillance and action.

5.2 Regulatory Challenges

5.2.1 India's Regulatory Trajectory

India's policy on cryptocurrencies has developed through improvisation rather than any deep thinking on the policy design. Last year's RBI circular largely prevented crypto businesses from using the banking sector, forcing many to relocate offshore and/or engage in informal arrangements. The 2020 decision overturned the sector, but the central bank's concerns that had prompted the central bank to reverse that decision remained unmitigated – albeit cast into a side pocket.

Fiscal clarity was provided in the 2022 Finance Act through provisions like a 30% tax on digital asset gains, all grants of losses were prohibited as offset to digital asset income and 1% TDS on qualifying transactions. These measures raise revenues and establish audit trails; however, they are more of a policy intervention on tax than a regulatory measure. They fail to even consider issues such as exchange licensing, consumer safeguards, custody rules, market manipulation and most importantly, environmental responsibilities. So, there is a large, active market operating without a government, too big to turn a blind eye to and too “ungoverned” to be safely played by participants.

5.2.2 Anti-Money Laundering Compliance

The nature of cryptocurrencies poses unique AML problems. The combination of pseudonymity and cross-border transferability with the irrevocability of confirmed transactions

gives rise to compliance complexity, well beyond the scope of traditional financial crime regimes. India has expanded PMLA requirements for VAPs, but there are gaps in enforcement. Adoption of the FATF's Travel Rule¹⁶, which necessitates sharing of originator and beneficiary data with transfers, is uneven, with compliance arbitrage that undermines global AML architecture.

5.2.3 International Regulatory Models

There are a few studies of international models to learn from. The MiCA Regulation, the EU's most comprehensive yet developed, not only mandates licensing requirements and establishes the consumer protection standards, but also introduces the rules pertaining to stablecoins, market integrity and — importantly — environmental disclosure obligations for crypto service providers. The last, in particular, is of great importance because it creates the first formal regulatory relationship between digital asset activities and climate responsibility.

A more pragmatic approach was taken by Japan, which determined that exchanges are financial institutions that also must be licensed, protect the assets of their customers, and must comply with measures to prevent money laundering, also resulting from a number of high-profile exchange failures. The Payment Services Act in Singapore is based on a risk-proportionate model with regulatory sandboxes to facilitate innovation along with regulation. No city, state or nation is more of an example to me than the United States regarding jurisdictional confusion: it has more than one agency whose purpose is to ensure its own jurisdiction gets effectively enforced, and compliance burden with no governance outcomes.

5.3 Environmental and Sustainability Implications

5.3.1 Energy Consumption and Carbon Footprint

Bitcoin's Proof-of-Work consensus mechanism that secures the network by letting miners race against each other to complete the calculation is currently estimated to use 150-170 TWh annually. The carbon-intensity of this consumption depends on geography, the type of energy used, but the overall environmental impact is huge on any reasonable assumptions around the make-up of the energy mix used in resource extraction.

¹⁶ Financial Action Task Force, *Updated Guidance for a Risk-Based Approach to Virtual Assets and Virtual Asset Service Providers* (2021).

However, it would be logically inaccurate to consider all cryptocurrencies as being equal in terms of their energy usage. The switch to Proof-of-Stake in Ethereum¹⁷, which happened in 2022, cut the use of energy by around 99.9 percent. By contrast, the following transition proves that security of a distributed ledger does not demand excessive energy precarities, just a bad design in some aspects (ecological difficulty isn't intrinsic to blockchain technology). The difficulty is very real but not technologically impossible.

5.3.2 Climate Governance Obligations

News of miners' voracious energy consumption can't live autonomously—it's part of the broader conflict that pits cryptocurrency mined energy against national emission reduction plans, corporate net-zero targets, and international climate deals. It would be difficult for jurisdictions with legally binding decarbonisation goals to be able to exclude digital asset activities from their climate accounting for energy intensity. It will take a variety of forms, such as carbon pricing for mining activities, renewable energy targets, disclosure obligations and exclusions in sustainable finance taxonomies, everywhere but it is not yet decided how it will be done. “But it is not something that can be put on the back burner without any repercussions.”

India has set ambitious targets under the Paris Agreement¹⁸ and is building a sustainable finance institutional framework at home. A cryptocurrency market where 115 million people are active—with no call for environmental accountability measures at play—is an easy-to-spot gap in that architecture and one that is becoming even more glaring.

5.3.3 Blockchain as a Sustainability Instrument

The blockchain has its pros, but not all of them are bad when it comes to sustainability. The technology can be used purposefully to deliver tools for environmental governance, such as supply chain traceability systems which enable environmental compliance claims to be auditable rather than just declared; carbon credit market infrastructure which can be better able to tackle issues of double-counting and fraud with transparent, immutable records; peer-to-peer renewable energy trading platforms powered by smart contracts; and environmental, social,

¹⁷ International Monetary Fund, *Global Crypto Market Report 2025* (2025)

¹⁸ United Nations Framework Convention on Climate Change, *Paris Agreement* art. 2, Dec. 12, 2015, T.I.A.S. No. 16-1104

and governance (ESG) reporting verification mechanisms which can enhance the credibility of corporate sustainability reporting. Distinct from the environmental costs of the mining operations that involve a lot of energy, these are applications that should be backed by policy.

5.4 ESG Integration

ESG direct contribution has expanded to a \$35 trillion worldwide market¹⁹, and with the development of cryptocurrency markets, it's getting ever closer. The dimensionality of ESG frameworks makes it difficult to make a precise classification: a crypto could have a low score in ESR, a reasonably good score in SS and a good score in G. Most traditional ESG ratings are not tailored for this type of asset, and often provide inaccurate ratings.

However, there are prospects for deliberate pairing. Blockchain projects that want to use a low-energy consensus mechanism, and a renewable-energy electricity supply, can feel the same when attracting ESG investors. Blockchain-based infrastructure for the issuance of green bonds, SLL, carbon markets operations proves to be aimed directly at the goal of ESGs. These opportunities do not simply manifest themselves if nothing is deliberately planned and supportive governance arrangements are not in place.

6. KEY FINDINGS

6.1 Economic Findings

Finding 1: Cryptocurrencies have reached the stage of magnitude that warrants serious discussion and serious regulation rather than treating it as a side activity. As such, overall market capitalisation has soared to USD 3.2 trillion and the number of cryptocurrency participants in India has risen to over 115 million (as of October 13, 2021).

Finding 2: Directly relevant to India's huge remittance inflows, there is a credible efficiency argument in support of cryptocurrencies as a mode of cross-border payments, and this is yet to be proven in terms of financial inclusion gains.

Find number 3: volatility of prices, rising integration with conventional financial markets lead to systemic risk mechanisms, which require close regulation.

¹⁹ European Securities and Markets Authority, *Crypto Assets and Risks for Financial Stability* (2024).

6.2 Regulatory Findings

Finding 4: Regulation is disjointed in the international cryptocurrency market, create opportunities for arbitrage and gaps in enforcement, and have a negative impact on consumer protection and integrity of the market internationally.

Finding 5: Absence of regulatory framework: There is no single regulatory framework in place, there are fiscal measures available relating to narrow concerns, they leave very big gaps in governance and do not pay much attention to environmental standards.

The EU's MiCA Regulation proves that sustainability disclosure can be pursued within comprehensive disclosure regimes which are also feasible, and can offer a good guide for other jurisdictions.

MLA Enforcement capacity is low and the MLA system is underdeveloped in India in terms of scale and sophistication of the virtual asset sector.

6.3 Environmental Findings

Finding 8: The PoW-based cryptocurrency mining uses 150-170 terawatt-hours of electricity per year, leading to heavy carbon emissions that result in concrete climate governance demands in the jurisdictions where mining takes place.

Finding 9: Alternative consensus mechanisms – specifically Proof-of-Stake – show that the issue of security for distributed ledger can be attained at a fraction of the energy required by Proof-of-Work, meaning that the energy problem is more about design decisions than it is fundamental to blockchain.

7. FRAMEWORK FOR SUSTAINABLE CRYPTOCURRENCY GOVERNANCE

The exponential growth of cryptocurrencies has transformed digital finance into one of the fastest-growing sectors of the global economy. By 2025, the global cryptocurrency market capitalisation exceeded USD 3 trillion, reflecting a substantial increase in institutional investment, retail participation, and blockchain-based financial innovation. India has emerged as a major participant in this ecosystem, consistently ranking among the leading countries in

cryptocurrency adoption²⁰. Reports indicate that India accounts for more than 115 million cryptocurrency users, while on-chain transaction volumes witnessed significant growth between 2024 and 2025. The increasing scale of digital asset activity has consequently intensified concerns regarding financial regulation, environmental sustainability, and governance accountability²¹.

A sustainable cryptocurrency governance framework requires balancing technological innovation with environmental responsibility. One of the most significant concerns relates to the energy-intensive nature of Proof-of-Work (PoW) blockchain systems, particularly Bitcoin. According to the Cambridge Blockchain Network Sustainability Index, Bitcoin's annual electricity consumption in 2025 was estimated at approximately 138 terawatt-hours (TWh), representing nearly 0.5% of global electricity consumption²². Earlier estimates by Digiconomist suggested annual consumption levels ranging between 100–170 TWh, exceeding the annual electricity usage of several developing countries. Such figures have intensified global debates regarding the compatibility of cryptocurrency expansion with international climate goals and sustainable development commitments²³.

The environmental implications of cryptocurrency mining extend beyond electricity consumption to carbon emissions and resource utilisation. Recent studies estimate that Bitcoin mining generates approximately 39.8 million tonnes of carbon dioxide equivalent (MtCO_{2e}) annually. Although renewable energy adoption within the mining sector has increased, sustainable energy currently accounts for only around 52% of global mining operations²⁴. This demonstrates that despite progress toward cleaner energy integration, substantial environmental risks remain embedded within digital asset infrastructure. Sustainable cryptocurrency governance therefore requires mandatory environmental disclosure obligations, carbon accounting mechanisms, and periodic sustainability assessments for large-scale blockchain operators²⁵.

International regulatory developments increasingly reflect the need for climate-conscious

²⁰ Binance News, *Cryptocurrency Market Cap Surpasses \$3 Trillion* (Mar. 2, 2025)

²¹ Chainalysis, *The 2025 Global Adoption Index (2025)*; Triple-A, *Cryptocurrency Ownership Data: India (2025)*.

²² Cambridge Centre for Alternative Finance, *Cambridge Blockchain Network Sustainability Index (2025)*

²³ Digiconomist, *Bitcoin Energy Consumption Index (2025)*.

²⁴ Cambridge Judge Business School, *Cambridge Study: Sustainable Energy Rising in Bitcoin Mining* (Apr. 28, 2025)

²⁵ Cambridge Digital Mining Industry Report (2025).

cryptocurrency governance. The European Union's Markets in Crypto-Assets (MiCA) Regulation represents one of the most comprehensive attempts to regulate digital assets through transparency, consumer protection, and sustainability reporting obligations²⁶. Recent policy discussions within the European financial framework have focused on requiring crypto-asset service providers to disclose environmental and climate-related impacts associated with blockchain operations²⁷. Such developments indicate a growing recognition that cryptocurrency governance must extend beyond financial compliance and incorporate environmental accountability standards aligned with ESG principles.

In contrast, India's cryptocurrency regulatory framework remains primarily focused on taxation and anti-money laundering compliance²⁸. The Union Budget 2022 introduced a 30% tax on gains arising from Virtual Digital Assets (VDAs), alongside a 1% Tax Deducted at Source (TDS) mechanism²⁹. Subsequently, in 2023, cryptocurrency exchanges and service providers were brought within the ambit of the Prevention of Money Laundering Act (PMLA). While these measures strengthened financial oversight and transaction monitoring, they did not address environmental sustainability concerns arising from blockchain operations³⁰. Consequently, India's existing framework lacks dedicated climate-sensitive governance mechanisms for digital assets.

A sustainable governance framework must further incorporate ESG-based disclosure obligations for digital asset enterprises. Global investment trends reveal that ESG-focused assets are expected to exceed USD 40 trillion by 2030, demonstrating growing investor preference for sustainable financial instruments³¹. As institutional participation within cryptocurrency markets increases, regulators are likely to demand greater transparency regarding energy sources, carbon footprints, and sustainability metrics associated with blockchain projects³². Mandatory ESG reporting requirements for cryptocurrency exchanges, mining entities, and blockchain infrastructure providers could significantly improve market accountability and investor confidence.

According to the technological innovation also provides opportunities for reducing the

²⁶ European Union, *Markets in Crypto-Assets Regulation (MiCA)* (2023).

²⁷ European Securities and Markets Authority (ESMA) Sustainability Consultation Reports (2024–2025).

²⁸ Finance Act, 2022.

²⁹ Ministry of Finance Notification Bringing VDAs under PMLA (2023).

³⁰ Reserve Bank of India Reports on Digital Finance (2024–2025).

³¹ Bloomberg Intelligence, ESG Market Outlook Report (2024).

³² United Nations Principles for Responsible Investment Reports (2024–2025).

environmental footprint of digital assets. The transition from Proof-of-Work to Proof-of-Stake (PoS) consensus mechanisms has emerged as a significant sustainability strategy. Ethereum's transition to PoS reportedly reduced its energy consumption by more than 99%, demonstrating the potential effectiveness of energy-efficient blockchain architectures³³. Similar technological adaptations, combined with renewable-energy-powered mining operations and carbon-neutral blockchain initiatives, can contribute substantially toward sustainable cryptocurrency governance without undermining innovation and market growth³⁴.

Another critical aspect of sustainable governance involves addressing financial stability and cybersecurity risks within digital asset ecosystems. Recent reports indicate that cryptocurrency-related thefts exceeded USD 2.17 billion during the first half of 2025 alone, surpassing the total losses recorded during the previous year³⁵. The increasing prevalence of cyberattacks, exchange breaches, and AI-driven financial fraud demonstrates the necessity for stronger governance standards concerning digital security, consumer protection, and operational resilience³⁶. Sustainable governance therefore requires integrating environmental sustainability with robust financial risk management and technological safeguards.

India's commitment to achieving net-zero emissions by 2070 further strengthens the need for climate-conscious digital asset regulation. As blockchain adoption expands across financial services, supply-chain management, digital identity systems, and public governance initiatives, regulators must ensure that technological growth does not undermine national sustainability objectives³⁷. The development of green blockchain standards, renewable energy incentives for mining operations, carbon disclosure mandates, and ESG-integrated digital finance regulations could facilitate a more balanced regulatory approach capable of supporting both economic innovation and environmental protection³⁸.

The sustainable cryptocurrency governance requires an integrated regulatory framework combining financial regulation, environmental accountability, technological innovation, and ESG-based oversight³⁹. The future of digital asset governance cannot be limited to taxation and compliance mechanisms alone. Instead, policymakers must adopt climate-conscious regulatory

³³ Ethereum Foundation, *The Merge Sustainability Reports (2023–2025)*.

³⁴ International Energy Agency Digital Energy Assessments (2024).

³⁵ Chainalysis Crypto Crime Reports (2025).

³⁶ Times of India, *Crypto Thefts Surpass USD 2.17 Billion (2025)*.

³⁷ Government of India, *Net-Zero Commitment Statements (COP26)*.

³⁸ Economic Times, *India's Web3 Ecosystem and Blockchain Adoption Report (2025)*.

³⁹ Cambridge Centre for Alternative Finance Reports (2025).

strategies capable of addressing the growing environmental footprint of blockchain systems while simultaneously promoting innovation, financial inclusion, and responsible digital economic development. Such an approach is essential for ensuring that the evolution of digital finance remains aligned with broader sustainability and climate governance objectives⁴⁰.

8. CONCLUSION

Cryptocurrencies have moved far beyond their origins as experimental digital payment systems and have evolved into a multi-trillion-dollar financial ecosystem that is increasingly intertwined with global capital markets, investment strategies, and digital economies. In India, the rapid growth of digital asset adoption reflects both the transformative potential of blockchain innovation and the growing complexity of regulating a technology that simultaneously affects financial stability, environmental sustainability, and economic governance. The debate surrounding cryptocurrencies can no longer be confined to questions of taxation, market speculation, or technological innovation alone. Rather, it demands a broader and more integrated understanding that brings together financial regulation, environmental governance, climate policy, corporate sustainability, and digital innovation within a unified framework.

The study demonstrates that while cryptocurrencies offer tangible benefits in the form of faster cross-border transactions, technological innovation, and opportunities for financial inclusion, these advantages are accompanied by significant risks. Market volatility, speculative trading behaviour, cybersecurity vulnerabilities, and the increasing integration of digital assets into mainstream financial systems pose challenges that extend beyond individual investors and have the potential to affect systemic financial stability. Consequently, regulatory intervention is not merely desirable but essential for ensuring responsible and sustainable growth of the digital asset ecosystem.

A more pressing concern, however, lies in the environmental consequences of energy-intensive blockchain networks. The substantial electricity consumption associated with cryptocurrency mining is not an incidental by-product but a structural characteristic of certain consensus mechanisms. As nations intensify efforts to achieve climate targets and fulfil sustainability commitments, permitting energy-intensive digital asset activities to operate outside meaningful

⁴⁰ *United Nations Sustainable Development Frameworks (2024–2025)*.

environmental accountability frameworks creates a significant governance gap. At the same time, blockchain technology itself possesses considerable potential to advance sustainability objectives through applications in carbon markets, ESG verification systems, supply-chain transparency, and climate reporting mechanisms. The challenge therefore lies not in rejecting digital assets, but in distinguishing sustainable innovation from environmentally harmful practices.

The findings of this research strongly support the adoption of a Sustainable Digital Finance Governance Framework that integrates financial oversight, environmental accountability, ESG compliance, technological innovation, and stakeholder participation. Such a framework must move beyond fragmented regulatory measures and establish comprehensive standards relating to licensing, consumer protection, environmental disclosures, carbon reporting, and climate-risk assessment. Equally important is the development of adaptive regulatory institutions capable of responding to technological evolution while maintaining regulatory certainty and investor confidence.

However, the future of cryptocurrency governance will be judged not merely by its ability to foster innovation but by its capacity to reconcile digital economic growth with the imperatives of environmental sustainability. A regulatory framework that ignores climate accountability risks becoming incomplete, ineffective, and inconsistent with national and international sustainability commitments. As India advances towards its net-zero ambitions and seeks to position itself as a global leader in digital finance, the integration of climate-conscious principles into digital asset governance is no longer a policy choice it is a regulatory necessity. The path forward requires a governance model that ensures innovation remains responsible, financial progress remains sustainable, and technological advancement contributes meaningfully to long-term environmental and societal well-being.

RECOMMENDATIONS

For Indian Policymakers

- Enact a comprehensive and dedicated cryptocurrency regulatory framework incorporating environmental sustainability and climate accountability principles.
- Introduce mandatory environmental disclosure and carbon reporting obligations for

cryptocurrency exchanges, mining operators, and digital asset service providers.

- Establish a multi-stakeholder advisory body comprising regulators, environmental experts, industry representatives, consumer groups, and civil society organisations.
- Integrate digital asset governance with India's Nationally Determined Contributions (NDCs), sustainable finance initiatives, and emerging green taxonomy framework.
- Develop specialised regulatory and enforcement capacity through technical training, digital monitoring tools, and institutional expertise in blockchain governance.
- Create a risk-based licensing and compliance regime for cryptocurrency businesses, incorporating ESG and sustainability standards.
- Promote international regulatory cooperation and information-sharing mechanisms to address cross-border cryptocurrency governance challenges.
- Encourage the adoption of renewable-energy-powered blockchain infrastructure and environmentally sustainable consensus mechanisms.

For ESG Investors and Institutions

- Develop robust ESG assessment frameworks specifically tailored to digital assets and blockchain-based investments.
- Evaluate cryptocurrencies based on factors such as energy consumption, carbon footprint, consensus mechanisms, and sustainability performance.
- Differentiate between blockchain projects rather than applying blanket inclusion or exclusion policies toward cryptocurrency investments.
- Engage proactively with cryptocurrency companies to improve environmental disclosures, sustainability reporting, and climate-related governance practices.
- Incorporate climate-risk assessment and environmental impact analysis into digital asset investment decision-making processes.

- Support regulatory initiatives that integrate ESG principles into cryptocurrency governance and digital finance regulation.
- Promote investment in sustainable blockchain technologies, green digital assets, and low-energy consensus models.
- Encourage greater transparency, accountability, and stakeholder engagement across the digital asset ecosystem.

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