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The global cryptocurrency market: empirical evidence and reflections on the green transition

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Abstract: The article presents an empirical study of the global cryptocurrency market in the context of its evolution under the influence of macroeconomic, technological and geopolitical factors, as well as the broader framework of the global green transition. By analyzing market dynamics across several critical periods, including the pre COVID crisis phase, the COVID 19 pandemic, the full scale russian invasion of Ukraine and the most recent stage of partial recovery, the study characterises the structural features of cryptocurrency volatility in comparison with traditional financial instruments, particularly the S&P 500 and USDX indices. The empirical component of the methodology is based on open access datasets from CoinMarketCap, TradingView and Investing, which enables a comparative assessment of cryptocurrency trends and stock market movements. The findings demonstrate that cryptocurrency markets remain highly sensitive to news flows, regulatory decisions and speculative activity by large investors, which complicates the application of conventional fundamental analysis methods. Special attention is devoted to the environmental dimension of crypto industry development. The high energy consumption of Bitcoin is identified as a major barrier to integrating blockchain technologies into sustainability oriented economic frameworks. The study also examines the potential of environmentally oriented tokens, most notably the Energy Web Token, which is positioned as a tool for supporting decarbonization processes in energy markets but continues to exhibit weak price performance and limited investor demand in comparison with green energy indices. The comparative analysis reveals a substantial gap between the conceptual value of green tokens and their actual market perception. Overall, the results confirm that despite the continuing expansion of the emergence of new technological solutions, the integration of crypto assets into the green transition remains fragmented. Meaningful advancement in this direction requires clearer regulatory frameworks, technological improvements and stronger alignment between blockchain applications and measurable environmental outcomes.

Keywords: cryptocurrencies, global financial market, blockchain, green transition, sustainable development, Bitcoin energy consumption, green token, decarbonization, EWT, S&P 500, USDX

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Introduction

The rapid digital transformation of the global economy has become a defining force reshaping international economic relations and accelerating the development of cryptocurrency markets. As digital assets increasingly influence global financial flows, the architecture of transnational investment, international trade, payment systems, and monetary policy, they have emerged not only as innovative financial instruments but also as integral components of a new phase in the evolution

of the world economic order. The relevance of studying the global cryptocurrency market is driven by several key considerations. First, the cryptocurrency sector continues to exhibit rapid growth, exerting a profound impact on the restructuring of the international financial system. Major global financial institutions now devote substantial attention to the regulatory implications of digital assets, highlighting the need for coherent governance frameworks. Second, the expanding ecosystem of cryptoassets has gained particular significance in the context of sustainable development. Concerns about the energy consumption of mining, the search for environmentally efficient alternatives, and the potential of blockchain solutions to enhance transparency and traceability in global supply chains have brought the intersection of cryptocurrency markets and green transitions to the forefront of scholarly debate. Third, geopolitical upheavals have introduced new dimensions to the study of cryptocurrency markets: digital assets have become instruments for mobilising international assistance, alternatives to traditional payment channels, and elements of digital resilience strategies in conditions of military conflict, sanctions pressure, and financial fragmentation.

Given these dynamics, analysing the structural and behavioural features of the global cryptocurrency market acquires not only financial and economic but also international strategic significance. Cryptocurrencies today shape patterns of global competition, influence regulatory trajectories, alter energy consumption profiles, and contribute to the institutional design of the emerging digital economy.

In 2024–2025, the global cryptocurrency market demonstrated both structural maturation and increasing alignment with sustainability goals. Empirical data indicate that the total market capitalization of digital assets fluctuated around USD 2.6–3 trillion by mid-2025, with Bitcoin and Ethereum maintaining a dominant 65% market share. However, recent analyses underscore a significant diversification toward energy-efficient "green" cryptocurrencies and stablecoins designed to mitigate volatility and environmental impact *(Koemtzopoulos et al., 2025)*

The comparative study of traditional and environmentally optimized cryptocurrencies reveals that several tokens (such as Cardano, Ripple, and Stellar) demonstrate short-term market efficiency and reduced energy intensity due to the adoption of Proof-of-Stake or hybrid consensus algorithms (Marques & Dias, 2025). This shift coincides with the forecasted post-halving stabilization of Bitcoin's price trajectory in 2025, which continues to act as a barometer for investor sentiment and long-term sustainability prospects *(Fabuš et al., 2024)*.

From an environmental perspective, recent assessments reveal that cryptocurrency mining remains a considerable source of carbon emissions, however with emerging signs of decarbonization through renewable integration and algorithmic optimization. Such mining is responsible for an estimated 0.25% of global CO_2 output and 0.5% of total electricity consumption (Laimon & Almadadha, 2025). The transition toward renewable-powered mining operations in North America and Scandinavia, alongside the increasing use of solar and wind curtailment, has begun to reduce the average carbon intensity of major blockchain networks by approximately 30% since 2022 (Winotoatmojo et al., 2024). Moreover, AI-enhanced blockchain infrastructures (such as those implemented in Render Network and Ocean Protocol) are projected to achieve up to 35% energy savings compared to traditional Proof-of-Work systems by leveraging adaptive learning for transaction optimization *(Kovács & Fűrész, 2025)*

Collectively, empirical data from 2024–2025 suggest that the cryptocurrency market is undergoing a structural transition toward a more resilient and environmentally responsible system. The convergence of AI, stablecoin governance, and renewable-powered mining indicates that the next phase of digital asset evolution may align more closely with global green transition objectives.

Thus, a review of scientific and analytical literature indicates that cryptocurrencies are examined through multiple research lenses, including the economic analysis of digital assets, regulatory policy, cross-border financial integration, and the macroeconomic effects of digital currencies. However, key questions remain insufficiently addressed, particularly those related to the scenario-based development of cryptocurrency markets under conditions of geopolitical turbulence, sustainability commitments, and the accelerating green transition. These gaps underscore the need for further empirical investigation and theoretical reflection within this rapidly evolving field.

Materials and Methods

The methodological framework of the study is based on a combination of quantitative and qualitative approaches aimed at analyzing the dynamics of the global cryptocurrency market and its interaction with traditional financial instruments and indicators of the green transition.

The empirical component of the methodology is grounded in the use of open-access data from three analytical platforms: CoinMarketCap (2025), TradingView (2025) and Investing.com (2025). Data from CoinMarketCap were used to analyse changes in the market capitalisation of major cryptocurrencies and the structure of digital asset dominance. TradingView was employed to construct comparative charts of green energy indices and to conduct a visual assessment of the volatility of Bitcoin and other assets across different time intervals. Data from Investing.com enabled the analysis of traditional financial indicators, including the dynamics of the S&P 500 and USDX indices, thereby facilitating a meaningful comparison between the cryptocurrency market and the stock and currency segments of the global financial system.

The study applies methods of comparative analysis, structural and dynamic analysis to identify relationships between market indicators and macroeconomic variables. Contextual analysis of the information environment was also used to evaluate the impact of news events and regulatory interventions on short-term cryptocurrency fluctuations.

To assess the environmental dimension of the cryptocurrency industry, a comparative approach was used to interpret the market behaviour of green energy indices and environmentally oriented tokens. This made it possible to identify disparities between the tangible influence of the energy sector and the conceptual positioning of “green” cryptocurrencies.

The methodological logic of the research follows a sequential progression from macro-level trends to structural market characteristics and culminates in the interpretation of empirical results within the broader context of sustainable development and the global green transition. This approach ensures the comprehensiveness and validity of the conclusions obtained.

Results

1. Overall Market Dynamics, Volatility Patterns and Macroeconomic Drivers in the Global Cryptocurrency Ecosystem

The empirical evidence collected for this study demonstrates that the global cryptocurrency market is characterized by pronounced structural sensitivity to macroeconomic shocks, technological shifts, regulatory interventions, and geopolitical disruptions. These forces shape volatility patterns, liquidity cycles, investor sentiment, and the broader integration of digital assets into the international financial system. For a comprehensive understanding of cryptocurrency market dynamics, it is analytically appropriate to situate the empirical assessment within distinct historical and geopolitical phases. Each phase reflects a unique configuration of risks, behavioral responses, and institutional adaptations, which together illuminate the nonlinear evolution of the global digital asset ecosystem.

In this regard, the trajectory of the global cryptocurrency market can be meaningfully examined through four interrelated temporal dimensions: the pre-COVID expansion period, the global COVID-19 crisis, the russia–Ukraine war as a geopolitical shock, and the approximation of future market dynamics in the context of the green transition and digital financial transformation (Table 1).

Following this periodization, the empirical dynamics of the global cryptocurrency market reveal a pronounced pattern of nonlinear expansion, punctuated by volatility shocks and structural adjustments. According to CoinMarketCap, global cryptocurrency capitalization has exhibited extraordinary fluctuations over the past decade *(CoinMarketCap, 2025)*.

While total market capitalisation amounted to approximately USD 15 billion in early 2017, it expanded to nearly USD 600 billion by the end of 2020 and surged to an all-time peak of almost USD 3 trillion in November 2021. The subsequent correction, however, illustrates the intrinsic instability of the sector: by December 2022, amid tightening monetary policy and geopolitical uncertainty, capitalisation had fallen to roughly USD 900 billion. More recent data underscore a partial recovery.

As of June 2025, the global market capitalisation of cryptocurrencies fluctuates around USD 2.3 trillion, driven by renewed institutional interest, the growth of tokenised financial products, and the increasing integration of energy-efficient blockchain consensus models. This pattern confirms not only the cyclical nature of the market but also its high sensitivity to macroeconomic signals and geopolitical disruptions.

Table 1. Analytical justification for the periodisation of global cryptocurrency market dynamics

Analytical Phase	Core Characteristics of the Period	Relevance to Cryptocurrency Market Dynamics
1. Pre-COVID Expansion (2016–2019)	Rapid technological scaling; institutional entry; growing retail adoption; emergence of DeFi; early regulatory debates.	Stable upward trend in market capitalisation; increasing liquidity; strengthening correlation with global equity indices; early manifestations of high-frequency volatility.
2. Global COVID-19 Crisis (2020–2021)	Macroeconomic uncertainty; monetary easing; fiscal stimulus; global digitalisation surge; supply chain disruptions.	Sharp volatility spikes; record inflows into digital assets as "alternative" stores of value; accelerated innovation in blockchain applications and stablecoins; increased systemic visibility of Bitcoin and Ethereum.
3. russia–Ukraine War (from 2022)	Geopolitical fragmentation; financial sanctions; currency instability; digital resilience strategies; rising defence-related cyber risks.	Cryptocurrencies used for cross-border donations and emergency liquidity; shifts in global risk appetite; renewed regulatory scrutiny; heightened short-term volatility in BTC and major altcoins.
4. Approximation of Future Dynamics (2025–2030, projected)	Institutionalisation of digital finance; green transition policies; carbon pricing; development of energy-efficient consensus mechanisms; AI–blockchain convergence.	Expectations of market maturation; potential stabilisation of volatility; transition from Proof-of-Work to energy-efficient protocols; expansion of tokenised assets and ESG-aligned crypto projects.

Source: the authors' arrangement

Understanding these dynamics requires situating cryptocurrency behaviour within major global events that have shaped investor expectations and market liquidity. Three turning points stand out:

1. The 2008 global financial crisis, which catalysed interest in decentralised alternatives to traditional financial systems;
2. The COVID-19 pandemic, during which unprecedented monetary easing and digitalisation waves fuelled a surge in crypto adoption;
3. The russian–Ukrainian war, beginning in 2022, which reinforced the strategic use of cryptocurrencies for cross-border transactions, humanitarian aid mobilisation, and as a hedge against financial restrictions *(Chen & Murtazashvili, 2023; Volosovych et al., 2024)*.

Together, these shocks illuminate the structural drivers behind the empirical volatility patterns observed in the crypto ecosystem and provide the foundation for interpreting current and future trajectories in the context of global financial transformation and the green transition.

Such volatility is even more apparent when cryptocurrency performance is compared with traditional financial indices. The S&P 500, representing the 500 largest U.S. corporations, experienced considerable turbulence during the pandemic and subsequent geopolitical shocks, yet its amplitude of fluctuation remained significantly lower than that of Bitcoin. Similarly, the U.S. Dollar Index (DXY), which captures the relative strength of the dollar against six major world currencies, shows variations that are comparatively modest when contrasted with the dramatic price swings characteristic of leading digital assets *(Borzenko et al., 2025)*. This divergence signals the distinct behavioural regime of the crypto market, where sentiment, liquidity cycles, speculative pressures, and technological triggers generate disproportionately sharp reactions.

The periodised analytical framework outlined above is further illustrated by the empirical behaviour of major global financial indices and the cryptocurrency market during 2021–2025. Figure 1 presents the dynamic of the S&P 500 index, which offers a useful benchmark for comparing the volatility of digital assets with that of traditional financial instruments.

Figure 1. Dynamics of the S&P 500 Index, 2021–2025 (USD)
Source: compiled from digital dashboard Investing.com (2025)

The S&P 500 trajectory clearly reflects market sensitivity to key global shocks. Although the 2008 financial crisis remains the most dramatic historical downturn (the index lost nearly 900 points) recent disruptions demonstrate analogous volatility mechanisms. During the peak of the COVID-19 pandemic in early 2020, the index dropped by approximately 400 points, driven by unprecedented uncertainty, global lockdowns, and liquidity withdrawals. Subsequent quantitative easing policies facilitated an accelerated rebound, pushing the index to new highs throughout 2021.

A new wave of turbulence emerged in February 2022 with the onset of russia's full-scale invasion of Ukraine, generating sharp risk-off reactions in global markets. The S&P 500 experienced another significant correction; however, volatility patterns differed in nature, displaying shorter recovery cycles and a more adaptive investor response. By mid-2024 the index resumed a strong upward trajectory, reaching approximately 5,900 points in early 2025, indicating structural resilience despite geopolitical fragmentation.

The USDX index, which captures the relative strength of the US dollar against a basket of six major world currencies (EUR, JPY, GBP, CAD, SEK, CHF), serves as a proxy for global risk sentiment and monetary tightening expectations.

Between 2021 and late 2022, USDX strengthened notably reflecting aggressive interest-rate hikes by the Federal Reserve and heightened safe-haven demand (peaking was near 26.3 points). In contrast, 2024–2025 demonstrates a stabilisation phase, with the index fluctuating around 25.6–25.8, signalling a softening of monetary conditions and gradual normalisation of global financial flows. These dynamics are important for understanding cryptocurrency markets, as periods of USD strength tend to correlate with reduced crypto-asset liquidity due to capital reallocation into lower-risk instruments.

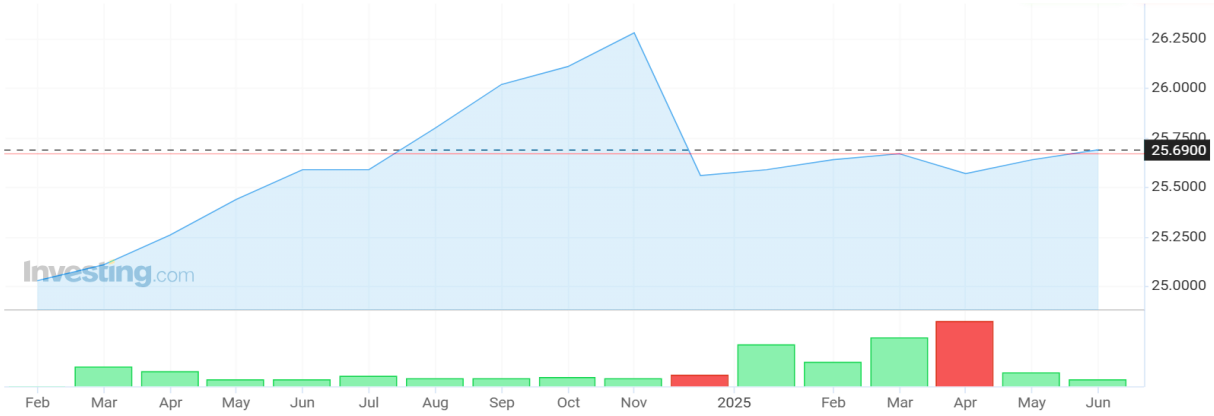

Figure 2. Dynamics of the USDX Index, 2021–2025 (USD)
Source: compiled from digital dashboard Investing.com (2025)

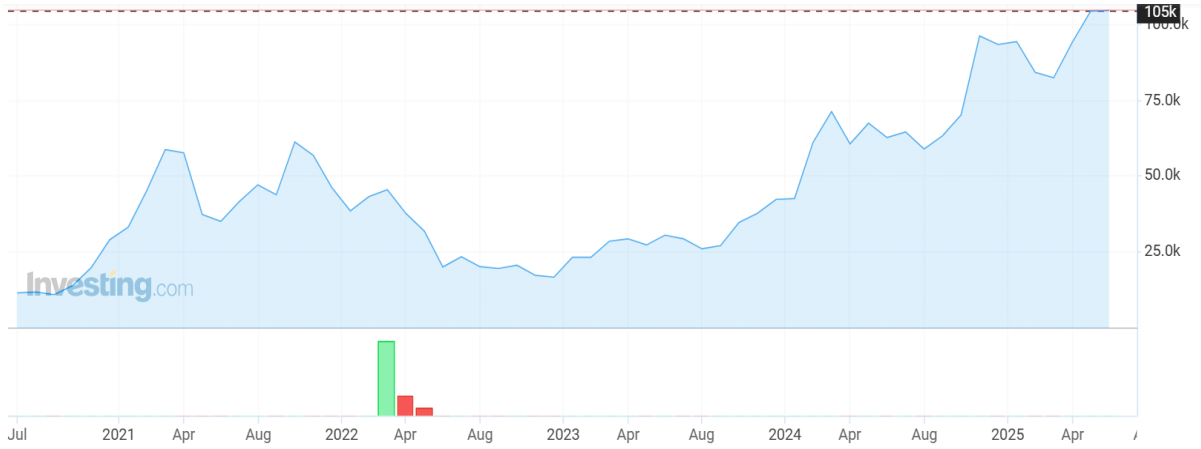

Figure 3. Bitcoin Price Volatility, 2021–2025 (USD)
Source: compiled from digital dashboard Investing.com (2025)

Bitcoin's behavior over the analyzed period markedly diverges from traditional financial indices. While the S&P 500 and USDX exhibit cyclical but relatively contained movements, Bitcoin demonstrates extreme amplitude fluctuations, reinforcing the argument that cryptocurrency markets operate within a distinct volatility regime.

From 2021 to mid-2022 Bitcoin oscillated between USD 30,000 and 65,000, reflecting speculative capital inflows, intensified retail participation, and exuberant expectations around institutional adoption. The collapse of several crypto-lending platforms and macro tightening pushed Bitcoin below USD 20,000 by late 2022. However, the recovery trend in 2024–2025 appears substantially stronger than after previous downturns. By early 2025, Bitcoin approached the USD 105,000 mark, largely driven by:

- increased institutional accumulation,
- expansion of exchange-traded digital asset products,
- the shift toward energy-efficient consensus mechanisms,
- broader integration of blockchain infrastructure across financial and industrial sectors.

These patterns highlight the core paradox of cryptocurrency markets – heightened volatility coexists with long-term upward structural momentum.

The comparative dynamics of the three indicators reveal several empirically grounded insights:

1. Cryptocurrency markets exhibit significantly higher volatility than equity or foreign-exchange markets. This volatility is amplified by speculative behavior, liquidity fragmentation, leverage cycles, and the influence of large holders. Macroeconomic and geopolitical shocks disproportionately affect digital assets *(Pysmennyi, 2023)*. For instance, the 2020–2021 monetary expansion fueled extreme upward movements, the 2022 russia–Ukraine war arose geopolitical shock,

that triggered abrupt corrections.

2. Media narratives and digital information flows intensify price dynamics. Viral messages such as "if you had invested in Bitcoin in 2010, you would be a millionaire now" reinforced speculative demand and broadened market participation *(Huynh, 2022)*.

3. Liquidity is improving over time, supported by rising transaction volumes and wider exchange platforms, indicating a maturing market ecosystem. However, such environment remain fragile *(Corobană, 2023)*.

4. Investor motivations increasingly combine financial and technological considerations, as blockchain expands beyond speculative use into real-sector applications, including energy management and decarbonisation solutions.

In the context of cryptocurrency markets, the application of fundamental analysis encounters several structural limitations and methodological challenges. One of the core distinctions between digital asset markets and traditional financial systems lies in the absence of a systematised and predictable news environment *(Prates & Fonseca, 2024; Vlahavas & Vakali, 2024)*. Unlike conventional markets, where news events are typically anchored in scheduled macroeconomic releases the information flow in cryptocurrency markets is fragmented, irregular, and often highly unpredictable. This fact is extremely relevant for GDP updates, inflation reports, labour market statistics, crude oil inventory data, or decisions on central bank policy rates.

This spontaneity severely complicates medium- and long-term forecasting of market trends. The challenge is further exacerbated by the relatively low degree of regulatory standardisation, which limits the development of a stable analytical environment for evaluating cryptoassets. Additionally, the partial detachment of cryptocurrencies from traditional financial market fundamentals reduces the applicability and efficiency of classical analytical approaches.

Despite these constraints, the evaluation of fundamental factors remains an essential component of investment decision-making within the cryptocurrency ecosystem. Relevant indicators include blockchain technical specifications, development activity, token use cases, network decentralisation, strategic partnerships, trading volumes, and regulatory signals. Systematic examination of these parameters enables the formation of more grounded expectations concerning the long-term potential of specific digital assets, even in an environment characterised by structural uncertainty and rapid technological change.

To complement the empirical assessment of market dynamics, it is essential to identify the cryptocurrencies that demonstrate the strongest growth potential in terms of market capitalisation. Table 2 presents a selection of digital assets that, according to aggregated market data and growth projections for 2025–2026, exhibit the most notable upward momentum and investor interest.

Table 2. Top-performing cryptocurrencies for 2025–2026 by market capitalization growth

Rank	Cryptocurrency	Annual Market Capitalisation Growth (2025)*	Projected Growth (2026)**	Key Drivers of Attractiveness
1	Bitcoin (BTC)	38.5%	22–27%	Institutional accumulation, ETF expansion, store-of-value narrative
2	Ethereum (ETH)	32.1%	18–25%	PoS scalability, DeFi and tokenisation infrastructure
3	Solana (SOL)	68.4%	30–40%	High throughput, growing developer ecosystem
4	Avalanche (AVAX)	41.7%	20–28%	Subnet architecture, enterprise integration
5	Toncoin (TON)	52.9%	25–35%	Integration in Web3 apps and messaging ecosystems
6	Chainlink (LINK)	29.6%	18–22%	Expansion of real-world asset (RWA) oracles

7	Polygon (MATIC)	24.3%	15–20%	Scaling solutions for Ethereum, enterprise partnerships
8	Internet Computer (ICP)	44.2%	22–30%	Decentralised cloud computing model
9	Binance Coin (BNB)	21.8%	12–18%	Strong ecosystem utility and liquidity
10	Optimism (OP)	47.5%	28–38%	Layer-2 adoption, rollup technology expansion

Source: authors' arrangement
* Annual Growth compiled from Investing.com (2025)
** Projected Growth is delivered by CoinMarketCap (2025)

Beyond the assets listed in Table 2, growing investor attention is increasingly directed toward cryptocurrencies that reflect the broader trends of the global green transition (Dziubliuk et al., 2025). Such sustainability-oriented tokens represent an emerging niche within the digital asset ecosystem. It is designed to incentivise renewable energy adoption, facilitate carbon credit markets, or support decentralised energy infrastructure. Although still characterised by high volatility and limited liquidity, such tokens align with long-term structural shifts in environmental policy, corporate decarbonisation strategies, and ESG investment frameworks. As regulatory landscapes evolve and climate-related financial disclosures gain prominence, the strategic relevance of "green cryptoassets" is expected to intensify.

2. Development of the Cryptocurrency Market in the Context of the Global Green Transition

The exceptionally high level of energy consumption required to sustain the world's largest cryptocurrency, Bitcoin remains one of the most critical technical and environmental challenges associated with conventional blockchain systems. Annual Bitcoin electricity consumption exceeds that of entire national economies such as the United Arab Emirates, underscoring a structural contradiction between energy-intensive Proof-of-Work mining and global decarbonization goals *(Hakimi et al., 2024; Wendi et al., 2023)*. This challenge complicates large-scale deployment of blockchain solutions across industries, as energy requirements act as a significant barrier to sustainable adoption *(Jones et al., 2022)*.

In response, developers and industry analysts have increasingly focused on designing blockchain architectures aligned with environmental and climate objectives. One of the most prominent initiatives in this domain is the Energy Web Token (EWT). This cryptocurrency was created to support decarbonisation processes in the energy sector by integrating blockchain technology with energy resource management. The token is central to the Energy Web Chain ecosystem, which aims to accelerate the transition to low-carbon energy systems (Figure 4).

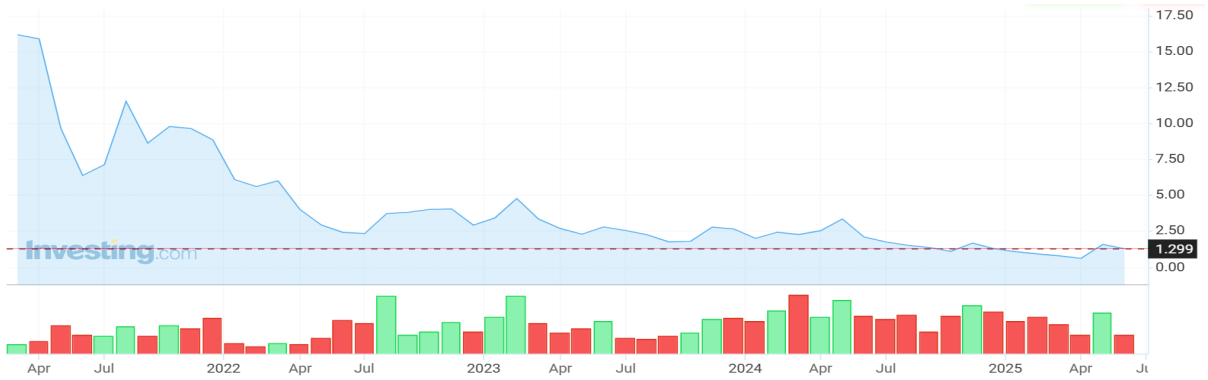

Figure 4. Dynamics of the Energy Web Token (EWT), 2022–2025 (USD)
Source: compiled from digital dashboard Investing.com (2025)

EWT performs three primary functions within the Energy Web Chain ecosystem (Vaccargiu et al., 2023):

First, EWT is used for all transaction fee payments. Since gas fees are not fixed, users can determine their own priority and cost depending on network load.

Second, EWT serves as the reward for validators responsible for block creation. With blocks generated approximately every five seconds, each of the around 40 validators produces a block roughly every two minutes. The standard reward per block is 0.8547 EWT (aprox. USD 3.20), which is significantly lower than Bitcoin's incentive of 6.25 BTC (over USD 120,000 at current prices). Importantly, Energy Web validators are primarily medium and large energy-sector companies participating for environmental and technological reasons rather than short-term financial gain.

Third, staking functionality is currently being rolled out. Two channels are being developed: relay Chain within the future Polkadot-based Energy Web Consortia ecosystem; Energy-sector DeFi platforms, such as ENGIE, offering an estimated APY of around 10% to EWT holders.

To improve interoperability, the Energy Web Foundation has also issued an ERC-20 compatible token, EWTB, allowing holders to bridge assets to Ethereum-based applications (Marin et al., 2023).

The broader context of the global energy transition highlights notable differences between the behaviour of real-sector clean-energy indices and sustainability-oriented cryptocurrencies. Figure 5 shows the dynamics of four major indices over the past year:

- MVIS® Global Low Carbon Energy Price Index (+8.93%)
- BlueStar® Global GreenTech Price Index (+8.15%)
- BlueStar® Wind Energy Industry Price Index (–2.66%)
- BlueStar® Solar Energy Industry Price Index (–29.77%)

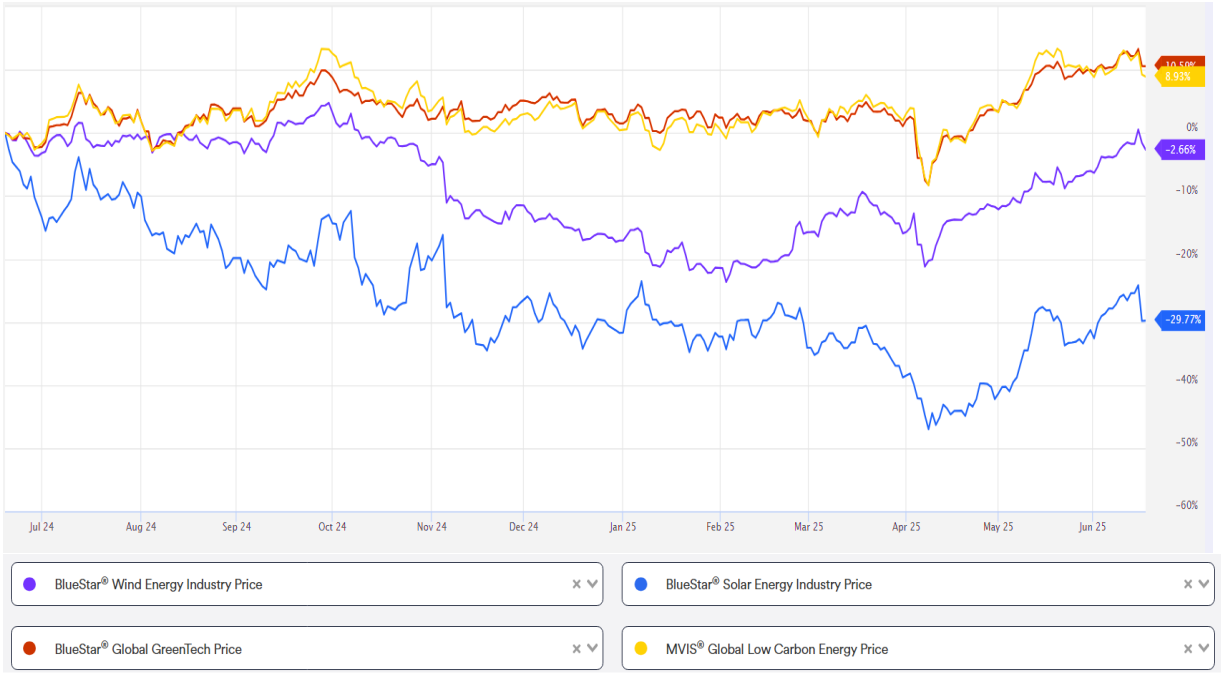

Figure 5. Dynamics of Green Energy Indices, 2024–2025
Source: compiled from digital dashboard TradingView (2025)

Low-carbon energy and broad green technology indices show positive growth, driven by rising institutional interest and increasing investment in companies implementing ESG strategies. In contrast, the solar sector's significant decline (about 30%) reflects supply-chain disruptions, competitive pressure, and changing regulatory frameworks *(Lukashevych, 2024)*.

Meanwhile, Energy Web Token demonstrates a prolonged downward trend. From peak values above USD 15 in 2021, EWT declined to approximately USD 1.30 in June 2025, with no sustained recovery signals. This divergence highlights a weak investor appetite for niche ESG-themed cryptocurrencies, despite their conceptual alignment with decarbonization objectives.

Table 3. Comparative Analysis of Green Energy Indices and the Energy Web Token (EWT)

Criterion	Green Energy Indices (ESG Sector)	Energy Web Token (Cryptocurrency)
Overall Trend	Predominantly upward, moderate growth	Declining since 2021, unstable dynamics
Investor Interest	Increasing, especially among institutional investors	Limited, weak market demand
Volatility	Low to moderate	High, typical for cryptoassets
Market Positioning	Real businesses with state support and revenue streams	Conceptual platform requiring broader market realisation
Integration into Decarbonisation Processes	Direct, embedded in energy systems	Indirect, with limited real-sector influence
Financial Stability	High, supported by predictable cash flows	Low, due to absence of stable income
Perceived Risk	Low	High

The comparative analysis reveals that traditional sustainable financial instruments (such as wind, solar, and low-carbon energy indices) demonstrate higher stability, predictability, and investor confidence than specialised environmentally-oriented cryptocurrencies. The empirical evidence suggests that investors currently favour proven business models with measurable environmental impact *(Maksymova & Nastase, 2024)*, whereas ESG-themed cryptoassets remain marginal within the sustainability investment landscape.

Despite the theoretical potential of tokens such as EWT to support decentralised energy markets, the lack of strong market demand, limited real-sector integration, and high volatility significantly constrain their adoption. As a result, digital sustainability tokens have not yet achieved meaningful correlation with broader decarbonisation trends.

This indicates a clear structural divide: real-sector green finance is advancing, whereas green-oriented cryptocurrencies remain experimental, awaiting either technological breakthroughs or regulatory frameworks that could support their mainstream integration.

Conclusions

The global cryptocurrency market demonstrates a nonlinear trajectory shaped by macroeconomic shocks, technological innovation, and geopolitical disruptions, including the COVID-19 crisis, monetary tightening cycles, and the russia–Ukraine war, each of which triggered significant volatility and shifts in investor sentiment. Market capitalisation dynamics confirm both extreme volatility and long-term structural expansion: from USD 15 billion in 2017 to nearly USD 3 trillion in 2021, followed by a correction to USD 900 billion in 2022 and a partial recovery to around USD 2.3 trillion by mid-2025. These fluctuations reflect heightened sensitivity to liquidity cycles, regulatory expectations, and global risk perception.

Cryptocurrencies exhibit significantly higher volatility compared with traditional financial instruments such as the S&P 500 and USDX, driven by speculative behaviour, fragmented liquidity, media influence, and the actions of large holders (“whales”). This reinforces the idea that crypto markets operate in a distinct behavioural regime compared to conventional assets.

The application of fundamental analysis in cryptocurrency markets remains constrained due to unpredictable news flows, limited regulatory standardisation, and weak linkage to macroeconomic fundamentals. Nonetheless, blockchain metrics, technological characteristics, developer activity, network use-cases, and regulatory signals remain essential components of long-term valuation.

Short-listed cryptocurrencies projected to grow in 2025–2026 (such as BTC, ETH, SOL, AVAX, TON, and others) show strong structural drivers of capitalisation growth, including institutional adoption, scalability improvements, tokenisation infrastructure, and DeFi integration.

These results indicate an ongoing market shift toward high-utility protocols.

The energy consumption of Bitcoin remains a fundamental contradiction between Proof-of-Work mechanisms and global climate goals, as BTC mining consumes more electricity annually than entire national economies. This reinforces the urgency of transitioning to energy-efficient consensus algorithms or low-carbon mining practices. The emergence of environmentally oriented blockchain solutions (such as Energy Web Token EWT) demonstrates attempts to align crypto technologies with decarbonisation policies, yet empirical evidence shows weak market demand and limited investor confidence in such ESG-themed tokens. Their conceptual value has not translated into stable financial performance.

A clear divergence exists between real-sector green energy indices and sustainability-oriented cryptoassets: while indices such as low-carbon energy and global green tech show positive annual returns, EWT continues a multi-year downward trend, signalling poor correlation with actual decarbonisation trends and highlighting the experimental status of green crypto tokens.

Institutional investors currently favour traditional green financial instruments over green cryptocurrencies, due to higher predictability, embedded real-sector cash flows, regulatory clarity, and measurable environmental contributions. In contrast, EWT and similar tokens face the challenges of high volatility, conceptual uncertainty, and weak integration into the energy market.

The overall empirical evidence suggests that the cryptocurrency market is undergoing a dual structural transition: on the one hand, toward technological maturity, institutional adoption, tokenisation and AI-enhanced blockchain models, and on the other hand - toward aligning digital asset infrastructure with the global green transition. However, this alignment remains partial. While real-sector green finance advances rapidly, environmentally oriented cryptocurrencies remain peripheral and have yet to demonstrate sustainable market traction or real-world decarbonisation impact.

Conflicts of interest

The authors declare that they have no conflict of interest.

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Authors contribution

Conceptualization: M.I. and K.V.; Methodology: M.I.; Formal analysis: M.I. and E.I.; Visualization: M.I.; Revision and editing: K.V. All authors have read and agreed with the published version of the manuscript.

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