International Journal of Financial Management
14 (2) 2024, 30-38
http://publishingindia.com/ijfm/

Unveiling the Potential and Challenges of Green Finance Empowered by Blockchain

Rajesh Sarvanarayan Jha*

Abstract

This research delves into integrating blockchain technology in green finance, uncovering its potential for amplifying transparency and efficiency in sustainable investments. It fills a void by elucidating blockchain's role within environmental and financial contexts and examining pragmatic applications under the Paris Climate Agreement. The study underscores how profoundly transformative blockchain can be, notably impacting energy distribution, waste management, and water resource monitoring. The research additionally emphasises the impact of blockchain on tokenisation strategies within the green bond market, a phenomenon that promotes liquidity and accessibility. It acknowledges promising opportunities and identifies challenges, such as funding gaps and regulatory structures prevalent in the renewable energy sector. The study highlights the need for customised regulations and an international framework to unleash blockchain's potential in sustainable finance.

Keywords: Blockchain, Green Finance, Tokenisation, Sustainable Development, Distributed Ledger Technologies, Regulatory Frameworks.

Introduction

Green finance refers to integrating environmental concerns into financial decision-making. It has gained increasing attention recently due to the growing awareness of climate change and sustainability issues (Treasury, 2021). According to the Intergovernmental Panel on Climate Change (IPCC), in order to avoid adverse effect of climate change substantial investments in adaptation and mitigation are necessary (IPCC, 2022). It encompasses a variety of financial instruments and services specifically designed to support and promote environmentally sustainable projects and initiatives (UNEP, 2021). It aims to mobilise financial resources towards activities that positively impact the environment and contribute to the transition to a low-carbon and sustainable economy (TaghiZadeh-Hesary & Yoshino, 2019). According to the World Economic Forum, blockchain can enhance trust in green finance by rendering environmental impact data more transparent and traceable (WEF, 2018). Previous research has explored the concept and principles of green finance and its applications in various financial sectors. However, comprehensive studies are still needed on the role of blockchain technology in green finance (Zhao, 2022).

Fig. 1 below illustrates how each stakeholder in the green finance ecosystem coordinates and acts to realise different green finance initiatives. It includes Government/ Regulatory bodies, investors, rating agencies, financial institutions, and research/advisory services. Government bodies in green finance are responsible for setting policies, regulations, and incentives. Individual and institutional investors are interested in allocating capital towards sustainable and socially responsible investments. Rating agencies establish guidelines, standards, and rating systems for evaluating financial products and investment's environmental and sustainability aspects. Financial institutions (Banks, investment firms, insurance companies, and other entities) provide financial products and services for green projects and initiatives. Research services offer analysis, research, and consulting services related to green finance and sustainable investing. Ultimately, it highlights each stakeholder's role in facilitating and promoting green finance activities.

* Assistant Professor, Department of Commerce, Purnea University, Bihar, India. Email: rajeshjha.pup@gmail.com .

Fig. 1: Green Finance Structure

The Paris Climate Agreement underwent a crucial review on May 6, 2022, with 192 nations adopting a more serious approach to environmental preservation and climate change. Notably, previously underestimated blockchain technology is now acknowledged as a potential tool for environmental conservation and resource collection (Morris & David, 2016). Blockchain technology is recognised as a valuable tool for traceable and transparent data, enabling investors to monitor the impact of climate change on green bonds and loans. Green financing aims to amplify financial flows for sustainable development, managing risks and capitalising on opportunities. Integration of blockchain technology enhances precision and transparency in navigating these challenges (Akaev et al., 2020).

Blockchain technology has evolved from being power-intensive to playing a pivotal role in sustainability initiatives. With a focus on achieving net-zero emissions by 2030, blockchain aims to leverage its unique capabilities to develop sustainable infrastructure solutions (IMF, 2021). Notably, it has the potential to revolutionise energy distribution by allowing users to connect directly to the grid, eliminating intermediaries, and reducing utility bills through wholesale pricing (Crosby et al., 2015). Additionally, blockchain technology can improve waste management systems by assigning a digital 'tag' to each item or batch of waste, ensuring accountability and reducing fraud. Integration with the Internet of Things (IoT) can monitor and manage water resources, promoting responsible usage and accountability for every drop. Implementing blockchain solutions, such as tokenising waste, ensures transparency and compliance, actively contributing to creating a sustainable future (Nazreen et al., 2023).

Blockchain Dynamics in Green Finance

Financial technology and green finance have emerged as crucial elements in modern society. These two components increasingly converge with economic development diversification (Yoshino et al., 2020). Fintech's role is evident in providing green financing by combining big data and artificial intelligence to accelerate the shift towards a sustainable economy. Moreover, Cen and He (2018) stated that fintech is crucial in promoting green finance. Schletz et al. (2020) have argued that energy efficiency interventions are slower due to specific market barriers. Blockchain technology, an example of fintech, can address such obstacles by altering energy system designs.

Green finance aims to better understand ecological impacts, diminish risk perceptions by prioritising sustainable investments over unsustainable ones, and foster transparency and long-term strategic thinking. The composition encompasses an extensive array of financial services and products: investments, the banking sector, and insurance; however, equity and debt emerge as the most prevalent components, a notable characteristic at play (Le et al., 2019). Green financing emphasises critical areas of interest: renewable energy investments, sustainable infrastructure finance, and green bonds (Azhgaliyeva & Liddle, 2020). The Governor of the Reserve Bank of India presented a unique alternative, emphasising the importance of increasing green finance flows to developing market countries, which are typically monopolised by established economies (RBI, 2023). This plan would focus on redirecting debt remissions towards sustainable development initiatives and poverty reduction campaigns, and it might include mechanisms like "debt for development swaps" and "green debt relief programmes."

In 2020-2021, the COVID-19 epidemic and worldwide economic slowdown led to a significant decrease in investment in renewable power, energy efficiency, and green projects. The COVID-19 epidemic and economic downturns led to a substantial drop in fossil fuel

costs. Low fossil fuel prices hinder renewable energy development, making solar, wind, and other resources less viable as electricity sources (Taghizadeh-Hesary, 2021). As a result, investor interest in clean fuels will decrease, jeopardising the Paris Agreement on climate change and other SDGs. The Paris Agreement on climate change is a fully operational accord following the COP 26 in November 2021, held in Glasgow. Adopted in 2015 and effectuated on November 4 of the subsequent year, this agreement noteworthily represents a pivotal moment for climate change procedures; it marks the first instance where nations collectively concurred upon ambitious measures to counteract and adapt to global warming processes (Tibrewal et al., 2023). Despite the agreement's comprehensive nature, it still harbours potential undermining factors due to existing loopholes and gaps, notably within Article 6. Concerns also arise over two main issues: first, a perceived lack of robust commitments from all parties, and second, inadequate climate financing for vulnerable nations. Countries persist in addressing these challenges head on by revising and fortifying their GHG mitigation goals. This includes formulating near-term emissions targets for 2030 and long-term net-zero emissions objectives. Advancements in science and technology, like the cost reduction of electric vehicles and battery storage, bolster the shift towards zero carbon emissions and stable concentrations of greenhouse gases. The Paris Agreement, a multilateral environmental accord that synthesises "top-down" with "bottom-up" approaches to tackle global emissions, enjoys universal support; it boasts active participation from across the international community (Jos Delbeke, 2019).

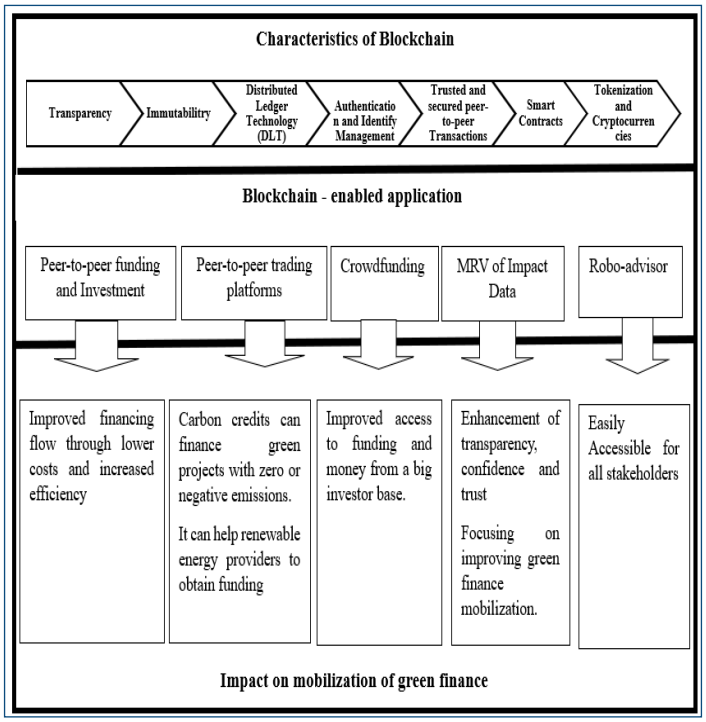

Fig. 2: Blockchain – Enabled Application and Impact on Mobilisation of Green Finance

Fig. 2 above illustrates the concept of a positive influence on the mobilisation of green funding. This concept, as represented in the figure, demonstrates both positive qualities and inherent restrictions; thus, it is critical to examine both elements while implementing such strategies.

Blockchain-driven solutions significantly shape the evolution of the green bond market, ushering in a new era of transparency, trust, and efficiency in sustainable finance. The transparency and traceability of blockchain technology can help build investor confidence and scale the green bond market (WEF, 2018). Blockchain technology, enabled by a decentralised and immutable ledger, securely records every transaction and outcome of green bond issuance; this ensures trust among investors while vastly opening up information avenues. The International Finance Corporation states that blockchain can make faster issuance and reporting of green bonds at greater efficiency with lower transaction costs (IFC,

2019). It offers an unparalleled advantage to stakeholders by helping them to track real-time environmental impacts and social returns on their investments. Adopting blockchain in the green bond market initiates a paradigm shift; it establishes an infrastructure that is robust and aligned with sustainability values and accountability.

Nuturing Green Finance: Blockchain-Based Initiatives

From a fringe and futuristic technology, blockchain technology has evolved into a powerful tool; it boasts numerous real-world applications. In green finance, where transparent, traceable information is critical for measuring climate impact, its significance must be balanced. Several key initiatives are reshaping the fintech sector in green finance, harnessing financial technology to promote sustainable growth, and addressing environmental challenges.

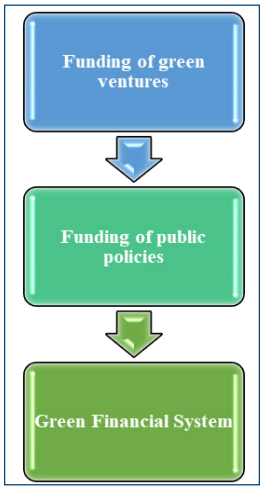

Fig. 3: Green Finance Landscape

The model of green financing provides a simple overview in Fig. 3: it begins with the funding for green ventures and extends further to the financing of public policies and research related to environmental conservation; ultimately, this facilitates development not only in terms of infrastructure but also towards an increasingly eco-friendly financial system; simultaneously fostering a society enriched by advanced infrastructure that enhances the quality of life. Consequently, several initiatives have been established to create blockchain-implemented solutions for monitoring and reporting environmental, social, and governance data, such as the Green Digital Finance Alliance (GDFA), Climate Chain Coalition (CCC), Stockholm Green Digital Finance and Canada Pension Plan Investment Board (CPP Investments).

Among these stands Stockholm Green Fintech, an initiative based in Sweden. Norway's Center for International Climate Research (CICERO) supports the Stockholm Green Digital Finance project. This venture employs the concept of sustainability attribution in green financial investments; CICERO anticipates equipping these investors with the necessary technology built on open-source platforms tailored for capital market participants to enhance the Paris Climate Agreement and SDGs goals attainment; the aim is to amplify the efficiency and transparency of transactions within green finance (CICERO, 2018).

The global operation Climate Chain Coalition (CCC) unites blockchain experts and environmental organisations to investigate how blockchain technology can combat climate change. We anticipate the coalition contributing across various areas, such as carbon accounting and supply chain transparency; this will highlight the transformative potential of blockchain within the green finance terrain (CCC, 2022).

An as-yet-unspecified initiative, Project Genesis, necessitates identification for a comprehensive analysis. Transitioning to the Green Asset Wallet will likely establish a digital infrastructure for managing and trading green assets. Potential features could encompass digital tokens representing green assets and streamlined verification processes, thus fostering increased liquidity and accessibility for eco-friendly investments (SEI, 2019). As a dedicated blockchain leverage platform for green energy financing, WePOWER is poised to significantly contribute to the growth of a decentralised energy marketplace.

The Green Digital Finance Alliance (GDFA), a collaboration between the United Nations Environment Programme and Ant Financial Services Group, undoubtedly concentrates on harnessing digital technologies to propel sustainable finance forward. This focus encompasses digital payments, climate risk assessments powered by fintech, and innovative green investment product development (GDFA, 2021). When evaluating the effect of these initiatives as integral components in steering the transformative agenda of green finance, we must consider technology integration, market sway, regulatory adherence, and strategic

partnerships: all critical factors indeed. When assessing these initiatives' impact, we must consider important factors such as technology integration, market influence, and regulatory compliance, which are all crucial for success. Additionally, strategic partnerships also play a significant role in this evaluation.

The Canada Pension Plan Investment Board (CPP Investments) has forged a long-term investment agreement with Power2X, a hydrogen project developer. CPP Investments will initially inject €130 million into this pact to reinforce Power2X's global standing in next-generation energy asset development and operation, particularly emphasising green hydrogen and other clean molecules. With an ambition to become an energy transformation leader, CPP Investments aims to acquire a controlling stake in Power2X; it perceives this partnership as strategically aligned towards that goal. Renowned for its large-scale energy initiatives, Power2X prioritises European demand through its diverse portfolio, including solar and hydrogen plants, alongside industrial-scale projects such as hydrogen production and green ammonia synthesis. Aiming to hasten the production of green chemicals, specifically hydrogen derivatives, this collaboration seeks to expedite the decarbonisation process in challenging industrial activities. The Sustainable Energies group at CPP Investments, boasting a portfolio worth C$32 billion, fervently pursues achieving net-zero greenhouse gas emissions by 2050: their partnership with Power2X bolsters its capacity for spearheading this transition towards environmental sustainability through molecular innovation, thus augmenting global efforts in rendering industries more carbon-neutral.

Tokenisation Strategies for Green Finance

Tokenisation converts real-world assets into digital tokens that can be bought, sold, and traded on cryptocurrency exchanges. Similarly, a token is a digital asset that represents ownership and management rights or claims to a physical or intangible item in the form of an object. Tokenisation reduces intermediaries (responsible for buying/selling/trading of the assets) and associated transaction costs and creates a transparent and censorship-resistant record of ownership. Green finance and tokenisation strategies can be combined to create innovative financial instruments that support sustainable projects and investments. For example, green bonds can be tokenized and traded on blockchain platforms, making it easier for investors to invest in sustainable projects. Additionally, green finance can be used to fund tokenization projects that support sustainable development and environmental protection.

Tokenisation's growing prominence within the green bond space represents a pivotal aspect of this evolution: converting traditional green bonds into digital tokens, facilitating fractional ownership and trade of smaller portions of eco-friendly assets (Staff C, 2021). This innovation offers manifold advantages; these include increased liquidity, reduced transaction costs, and enhanced capital mobilisation. Both institutional and individual investors reap the benefits of the fractional ownership model, which improves accessibility and cost-effectiveness for green investments. Moreover, combining blockchain-driven transparency with tokenisation is actively reshaping and redefining the green bond market; this strategy fosters a more responsive environment tailored to meet diverse needs within an expanding investor base.

Tokenisation facilitates traditional green bonds and introduces do-it-yourself (DIY) bonds and platforms for fractional asset ownership. Investors can customise their green investment portfolios to match their preferences and risk appetites. This access democratisation expands the scope of the green bond market, drawing in a diverse base of investors. Consequently, sustainable finance inclusively aligns with expansive environmental and social objectives. Blockchain-driven solutions intersect with tokenisation while simultaneously expanding investor accessibility; this exemplifies a dynamic metamorphosis within the green bond market, fostering an impact that is both a sustainable and profitable investment landscape (Nazreen et al., 2023).

In the coming years, the tokenisation of renewable energy credits and carbon offsets will emerge as one of the most actively traded assets. Global Market Insights (2023) also reports that trading on carbon credits is widespread, and it anticipated a compound annual growth rate of 14.8% from 2024 to 2032. The concept of tokenised carbon offsets offers a more transparent and accessible alternative to traditional carbon credit markets. A few of the projects are as follows:

Dexstar (2023) DeFi protocol tokenises debt positions in sustainable projects like renewable energy and green tech

initiatives using ERC-721 tokens. This allows for more transparent and efficient financing of these green projects through the tokenised debt positions.

Penomo (2024) has tokenised battery storage assets into fractional, tradable entities. This strategy will help battery makers and operators access global financing more efficiently to build out battery storage capacity, which is crucial for renewable energy adoption and grid stability.

Plural Energy's (2023) platform tokenises renewable energy assets like solar fields, wind farms, and battery storage projects. It issues security tokens representing digital equity shares in these green energy projects, making them accessible to more investors.

Frigg (2022) enables sustainable infrastructure developers to issue digital tokens backed by their projects. It uses IoT technology to provide real-time data on the performance of these green infrastructure projects for transparency.

Allfunds Blockchain (2024) While not directly tokenising green assets. Allfunds has leveraged blockchain to launch Spain's first tokenised fund in 2022, demonstrating the application of tokenisation in the fund industry, including for potential green/ESG funds.

These projects showcase that tokenisation is being utilised to fragment this ownership structure, making it increasingly conducive for diverse participants and more efficient in how green assets get built and financed with increased transparency.

Addressing Challenges in Green Finance Innovation

Several challenges inhibit the progress of green finance innovation in tackling environmental and sustainability issues: a significant funding gap and insufficient attention to ecological and biodiversity protection by both financial institutions and institutional investors, culminating from an economic recession that has curtailed investments in these areas (CCICED, 2023). Nevertheless, we must forge ahead with innovative solutions rooted in finance technology, as they are indispensable tools for addressing climate change while fostering growth with eco-consciousness. Green financial innovation involves developing and innovating eco-friendly financial products, including but not limited to green bonds and loans. Conversely, advancements in green tech concentrate on sectors such as energy, transportation infrastructure construction, and buildings (Shah et al., 2023). To expedite the establishment of these environmentally beneficial technologies, models for financing risk management within our current financial system must incorporate government incentives alongside long-term funding strategies, all underscored by an emphasis on digital solutions (Nadia, 2023).

Comprehensive regulatory frameworks significantly challenge the renewable energy sector. The sector needs more well-defined guidelines and regulations and can achieve its total growth and sustainability potential. Clear regulatory frameworks are absent; this impedes standardised practice development, a challenge for businesses and investors seeking confident navigation in the renewable energy landscape. Not merely impeding project implementation, this regulatory vacuum also engenders uncertainty regarding permitting, grid access, and financial incentives, thus obstructing the overall progress and scalability of renewable energy initiatives at the graduate level.

Regulatory frameworks inherently tie the viability of renewable energy projects. Project developers and investors introduce risk and uncertainty depending on these frameworks. Potential investors may be deterred by stable, supportive regulations as they seek assurance and predictability in investment returns (Schletz et al., 2020). Moreover, fluctuations or uncertainties in regulatory policies may hinder the financial and operational planning of renewable energy projects; therefore, a stable regulatory environment remains essential for this sector. It is imperative to attract necessary investments and cultivate sustained growth.

The renewable energy sector not only grapples with a shortage of regulatory frameworks but also confronts risks tied to technology, fraud, and market oversight; this is an ongoing issue. The industry's rapid technological advancements can present uncertainties. Will they guarantee the long-term viability and compatibility of existing projects? Also, it is crucial to note that in the absence of robust market supervision or enforcement mechanisms, there may be exposure to fraudulent activities, which could significantly erode investor confidence (IEA, 2017). To address these risks, we must establish clear and enforceable regulatory frameworks; they should provide guidance and ensure a level playing field. This approach will foster innovation, an essential

element in the dynamic nature of the renewable energy sector; simultaneously, it will mitigate potential pitfalls associated with this volatility.

Conclusion and Policy Imperatives

Emerging as a transformative force in sustainable investments, blockchain technology offers unparalleled transparency, traceability, and security. Its decentralised nature guarantees an immutable ledger that establishes a transparent record of transactions resistant to tampering. This capability proves essential for sustainable finance, where paramount importance lies in accountability and fund traceability. Through blockchain leverage, sustainable investments achieve enhanced credibility, which draws in environmentally conscious investors and nurtures a more robust ecosystem for green projects.

The potential benefits of blockchain in green digital finance are significant; however, a lack of supportive regulations presents an undeniable hurdle. It is crucial to advocate for regulatory frameworks, specifically tailored to the unique needs of sustainable finance. This will unlock blockchain's full potential. By providing clear and supportive regulations, we can offer necessary guidance for industry players, fostering innovation while ensuring compliance with environmental and social standards. Advocacy efforts must strive to foster an environment conducive to blockchain's thriving as a tool in sustainable finance, strategically balancing innovation and regulatory oversight.

There is a compelling need for an international framework. This is what bolsters the global adoption of blockchain in sustainable finance. We can streamline cross-border transactions by proposing and establishing standardised protocols; such a measure guarantees consistency and interoperability. The benefits of creating an international framework extend beyond addressing regulatory uncertainties. It would foster collaboration between nations, thus building a cohesive, interconnected global sustainable finance infrastructure. Such a framework fosters knowledge-sharing and the dissemination of best practices, thereby intensifying blockchain's positive influence on sustainable finance. Equally pivotal is our insistence on empirical analysis to validate blockchain's effectiveness in mitigating financial expenditures and risks in eco-friendly industries. Rigorous evaluations and case studies furnish concrete evidence of these advantages and actions that bolster investor confidence and stakeholder faith. Shaping informed decisions and optimising the integration of blockchain technology into sustainable finance practices necessitate this empirical approach.

References

Akaev, A. A., & Davydova, O. I. (2020). The Paris agreement on climate is coming into force: Will the great energy transition take place? *Herald of the Russian Academy of Sciences, 90*, 588-99. doi:https://doi.org/10.1134/S1019331620050111

Allfunds Blockchain. (2024). *Why Allfunds blockchain?* Retrived from https://allfunds.com/en/distributors/blockchain/

Azhgaliyeva, D., & Liddle, B. (2020). Introduction to the special issue: Scaling up green finance in Asia. *Journal of Sustainable Finance & Investment, 10*(2), 83-91. doi:https://doi.org/10.1080/20430795.2020.1736491

Climate Chain Coalition (CCC). (2022). Retrieved from https://climatechaincoalition.org/#:~:text=The%20Climate%20Chain%20Coalition%20(CCC,enhance%20MRV%20(measurement%2C%20reporting%20and

China Council for International Cooperation on Environment and Development (CCICED). (2023). Green finance. In: Green recovery with resilience and high quality development. doi:https://doi.org/10.1007/978-981-19-9470-8_9

CICERO. (2018). *Scaling green investments through blockchain.* Retrieved from https://www.cicero.oslo.no/en/posts/prosjekter/scaling-green-investments-through-blockchain

Crosby, M., Pattanayak, P., Verma, S., & Kalyanaraman, V. (2016). Blockchain technology, beyond bitcoin. *Applied Innovation, 2*, 71.

Dextar. (2023). *How do the debt vault works?* Retrieved from https://dexstar.gitbook.io/dexstar-whitepaper/introduction/how-do-the-debt-vaults-work

Taghizadeh-Hesary, F., & Yoshino, N. (2019). The way to induce private participation in green finance and investment. *Finance Research Letters, 31*, 98-103. doi:https://doi.org/10.1016/j.frl.2019.04.016s

Frigg. (2022). *Traditional and decentralized finance can work together to fund renewable energy and other sustainable projects.* Retrived from https://

www.frigg.eco/journal/article/how-does-defi-improve-the-bottlenecks-of-traditional-finance-in-sustainable-financing

GDFA. (2021). *Interim report: A green fintech taxonomy and data landscaping.* GDFA and Swiss Green Fintech Network. Retrieved from https://www.greenfinanceplatform.org/sites/default/files/downloads/resource/GreenFintechTaxonoGreenFintechTaxon-v5%20.pdf

Inernational Energy Agency (IEA). (2017). *World energy outlook 2018: China.* Retrieved from www.iea.org/weo/china/#section-7)

IMF. (2021). *Reaching net zero emission.* Retrieved from chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.imf.org/external/np/g20/pdf/2021/062221.pdf

IPCC. (2022). *Climate change 2022: Impacts, adaptation and vulnerability. intergovernmental panel on climate change.* Retrieved from https://www.ipcc.ch/report/ar6/wg2/

Le, J., & Zhao, R. (2019). Research dynamics of blockchain technology in green finance. *Journal of Finance and Accounting Monthly, 13*, 172-176.

Delbeke, J., Runge-Metzger, A., Slingenberg, Y., & Werksman, J. (2019). *The Paris agreement.* Retrieved from https://www.taylorfrancis.com/chapters/oa-edit/10.4324/9789276082569-2/paris-agreement-jos-delbeke-artur-runge-metzger-yvon-slingenberg-jake-werksman

Erickson, L. E., & Brase, G. (2019). *Paris agreement on climate change* (1st ed., p. 12). CRC Press. Retrieved from https://www.taylorfrancis.com/chapters/oa-edit/10.1201/9781351116589-2/paris-agreement-climate-change-larry-erickson-gary-brase

Le, T. H., Chuc, A. T., & Taghizadeh-Hesary, F. (2019). Financial inclusion and its impact on financial efficiency and sustainability: Empirical evidence from Asia. *Borsa Istanbul Review, 19*(4), 310-322. doi:https://doi.org/10.1016/j.bir.2019.07.002

Mansour, N. (2023). Green technology innovation and financial services system: Evidence from China department of finance. *Businesses, 3*, 98-113. doi:https://doi.org/10.3390/businesses3010008

Morris, D. Z. (2016). *Leaderless, blockchain-based venture capital fund raises $100 Million, and counting.* Retrieved from https://fortune.com/2016/05/15/leaderless-blockchain-vc-fund/

Junaidi, N., Abdullah, M. P., Alharbi, B., & Shaaban, M. (2023). Blockchain-based management of demand response in electric energy grids: A systematic review. *Energy Reports, 9*, 5075-5100. doi:https://doi.org/10.1016/j.egyr.2023.04.020

Naderi, N., & Tian, Y. (2022). Leveraging blockchain technology and Tokenizing green assets to fill the green finance gap. *Energy Research Letters, 3*(3). doi:https://doi.org/10.46557/001c.33907

Penomo. (2024). Retrived from https://penomo.io/

Plural Energy. (2023). *Using DeFi to finance the clean energy transition.* Retrived from https://blog.pluralenergy.co/using-defi-to-finance-the-clean-energy-transition

RBI. (2023). *India RBI chief says urgent need to boost green finance flows to emerging markets.* Retrieved from https://www.reuters.com/world/india/india-rbi-chief-says-urgent-need-boost-green-finance-flows-emerging-markets-2023-08-11/

Schletz, M., Cardoso, A., Prata, Dias, G., & Salomo, S. (2020). How can blockchain technology accelerate energy efficiency interventions? A use case comparison. *Energies, 13*(22), 5869. doi:https://doi.org/10.3390/en13225869

Schletz, M., Nassiry, D., & Lee, M.-K. (2020). Blockchain and Tokenized securities: The potential for green finance Asian Development Bank Institute. ADBI Working Paper, 1079. Retrieved from https://www.adb.org/sites/default/files/publication/566271/adbi-wp1079.pdf

SEI. (2019). *The green assets wallet – First blockchain for green bond impact.* Retrieved from https://www.sei.org/about-sei/press-room/first-blockchain-for-green-bonds/

Shah, S. B., Sopin, J., Techato, K.-A., & Mudbhari, B. K. (2023). A systematic review on Nexus between green finance and climate change: Evidence from China and India. *International Journal of Energy Economics and Policy, 13*(4), 599-613. doi:https://doi.org/10.32479/ijeep.14331

Staff, Cryptopedia. (2021). *What is Tokenization?* Retrieved from https://www.gemini.com/cryptopedia/ what-is-tokenization-definition-crypto-token

Taghizadeh-Hesary, F., Yoshino, N., & Phoumin, H. (2021). Analyzing the characteristics of green bond markets to facilitate green finance in the post-COVID-19 world. *Sustainability, 13*, 5719. doi:https://doi.org/10.3390/su13105719

Cen, T., & He, R. (2018). *Fintech, green finance and sustainable development* (pp. 222-225). Atlantis Press. 222-225. doi:https://doi.org/10.2991/meeah-18.2018.40

Tibrewal, K., Tanaka, K., Boucher, O., & Ciais, P. (2023). Levers of climate pledges influencing the Paris agreement target. *EGU General Assembly*, 24-28. doi:https://doi.org/10.5194/egusphere-egu23-6566

Treasury, H. M. (2021). *Greening finance: A roadmap to sustainable investing.* Retrieved from https://www.gov.uk/government/publications/greening-finance-a-roadmap-to-sustainable-investing

UNEP. (2021). *Green finance.* Rerieved from https://www.unep.org/regions/asia-and-pacific/regional-initiatives/supporting-resource-efficiency green-finance

WEF. (2018). Building Block(chain)s for a Better Planet. Retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www3.weforum.org/docs/WEF_Building-Blockchains.pdf

Yoshino, N., Morgan, P. J., & Long, T. Q. (2020). *Financial literacy and Fintech adoption in E7 countries.*

Zhao, X. (2022). *How blockchain can empower the growth in green finance* (pp. 412-416). Atlantis Press. doi:https://doi.org/10.2991/978-94-6463-036-7_60