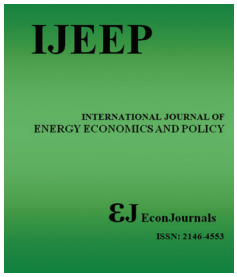

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2026, 16(2), 47-57.

Leveraging FinTech-Driven Financial Inclusion and ESG Integration to Advance Affordable and Clean Energy Access

Ohoud Khasawneh[1], Amro Alzghoul[2]*

[1]Department of Finance and Financial Technology, Faculty of Business, Amman Arab University, Jordan, [2]Department of Business Administration, Faculty of Business, Amman Arab University, Jordan. *Email: azghoul@aau.edu.jo

Received: 13 August 2025 **Accepted:** 26 December 2025 **DOI:** https://doi.org/10.32479/ijeep.22086

ABSTRACT

The paper discusses how digital financial inclusion powered by financial technology and incorporation of environmental, social, and governance principles into finance can hasten the achievement of Sustainable Development Goal 7. We provide a systematic literature review, which relies on peer-reviewed literature in energy economics, sustainable finance, and development literature. Our search and screening strategy is informed by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The analysis shows that financial inclusion, which is promoted by FinTech (e.g. mobile banking, digital lending, and crowdfunding) has increased access to energy (e.g. pay-as-you-go solar, microfinance to clean cooking) especially by underserved communities in Asia, the Middle East and Africa. At the same time, the ESG consideration in financial decision-making is directing investments to renewable energy and energy efficiency initiatives. We discover that digital platforms and blockchain-based tools increase the levels of ESG data transparency and integrity, and strengthen the confidence of investors in green energy ventures. Nonetheless, it is also evidenced that financial inclusion should be accompanied with the introduction of clean energy to prevent the need to emit more carbon into the air through the consumption of additional energy. Our research gaps are household-level behavior, ESG adoption in developing markets and FinTech governance. Government and industry policies like subsidizing energy delivery through digital payments and requiring ESG reporting of FinTech companies will have the effect of making digital finance and sustainability agendas mutually reinforcing. All these points highlight the cross-cutting enabling nature of FinTech in sustainable energy shifts and the need to collaborate interdisciplinarily to utilize digital finance to achieve global clean energy targets.

Keywords: Affordable and Clean Energy, Digital Financial Inclusion, ESG Integration, FinTech, Sustainable Development Goals, Sustainable Energy
JEL Classifications: G21, O16, Q42, Q56

1. INTRODUCTION

The idea of universal access to affordable, reliable, sustainable, and modern energy is one of the pillars of the 2030 Agenda for Sustainable Development, which was formalized as Sustainable Development Goal 7 (SDG7) (El-Khadiri et al., 2025). Achieving the targets set by SDG7 involves much more than providing universal access to electricity and clean cooking fuels; it also involves increasing the share of renewable energy and enhancing the global energy efficiency levels significantly (Zhang et al., 2021). Addressing these challenges around energy access will require historically high investments and the accelerated development of sustainable energy infrastructure. Thus, the salient importance of inclusive and affordable ESG-integrated pivot financing to enterprises within these businesses becomes crucial in the provision of energy-related sustainability. Finance The power of FinTech (financial technology) has catalyzed digital financial inclusion, which has grown at a fast rate in the last ten years; creating new avenues to finance and provide clean energy. FinTech innovations, including mobile banking and e-wallets,

peer-to-peer lending platforms, etc., allow delivering cheap and convenient financial services to previously unbanked populations through the internet and mobile phones (Ha et al., 2025). As an illustration, mobile money has been particularly disruptive in places such as East Africa, where customers can store, borrow or pay money remotely, and initiate a network of micro-investments in off-grid solar products through pay-as-you-go plans (Tay et al., 2022). This digital inclusion is directly connected to SDG7: Given that households are able to access financing on flexible terms with the help of technology, it becomes easier to afford clean energy installations (such as a solar home system or the biogas digester) that will help them to reduce reliance on expensive and polluting fuels (Tay et al., 2022). FinTech is therefore a cross-cutting enabler connecting the financial requirements of underserved communities with sustainable energy solutions.

Simultaneously, the emergence of the ESG integration into the financial market is transforming the distribution of capital towards sustainability. ESG criteria are a wide range of Environmental, Social, and Governance variables that can be applied to assess corporate and investment performance when the company is not measured by the usual financial metrics (Li et al., 2024). One of the focuses of this ESG trend is energy: Institutional investors and lenders are increasingly questioning the carbon footprint, communal effect, and governance strategies of energy enterprises and undertakings (Galeone et al., 2024). This has led to a shift in finance towards renewable energy, energy efficiency, clean technology projects as a result of this trend in addition to climate change issues. FinTech has a complementary role in this case by enhancing transparency, effectiveness, and accessibility of sustainable finance. Small-scale green investments (e.g. crowdfunding of solar farms) may be aggregated via digital, and blockchain and big data analytics imply a higher level of ESG performance tracking and reporting in real time (Rezaee and Tuo, 2019). Energy marketplaces provide an example of digital innovations trying transparent peer-to-peer trading of pollution-free renewable electricity with a record of carbon savings and a potential bypass of the funds diversion that finances pollution. Such digital innovations could further tackle the persistent challenges in the sustainable energy finance landscape, such as sustained high transactional value, information asymmetry, and potential green washing (Huang et al., 2025) or simply low-priced unethical green finance. This will contribute positively towards the prompt adoption of clean energy technologies in the context of achieving SDG7.

Nevertheless, the inappropriate linking of digital financial inclusion, ESG investment, and sustainable energy leaves considerable knowledge gaps. The available literature predominantly treats financial inclusion, ESG finance, and energy access as distinct and unrelated silos with limited interdisciplinary integration. This study seeks to fill this gap primarily by reviewing and synthesizing recent literature at the interface of FinTech, ESG, and SDG7. More specifically, we explore how FinTech-enabled digital financial inclusion and ESG integration in finance advance the SDG7 goals, and the resulting challenges and opportunities that the interplay presents. In line with this objective, the following research questions guide this analysis and should be included.

(1) In what ways do FinTech innovations in digital financial services facilitate greater access to affordable clean energy, particularly for unbanked or underserved populations?
(2) How does the integration of ESG criteria in financial systems influence investments in renewable energy and energy efficiency, and how can digital technologies enhance this influence?
(3) What are the synergistic effects, if any, of combining FinTech-driven inclusion with ESG-focused finance on sustainable energy outcomes, and what barriers might hinder these synergies?

2. THEORETICAL AND CONCEPTUAL BACKGROUND

2.1. FinTech and Digital Financial Inclusion

Digital financial inclusion involves applying digital technologies to reach every excluded group in formal finance with affordable, safe financial services, enhancing access, utilization, and the quality of services (Tay et al., 2022). The key driver is FinTech, which is the technological innovation transforming the world of finance, which has increased the use of mobile money, e-wallets, and agent banking to allow users to make transactions through phones without visiting the branches (Al-Kasasbeh et al., 2023; Alzghoul and Al-kasasbeh, 2024; Ha et al., 2025). It also facilitates digital credit and insurance with the use of alternative data to serve thin-file customers (Mhlanga, 2022). These vehicles are particularly powerful when it comes to energy access. Mobile banking supports pay-as-you-go (PAYG) solar models, which transform high initial investment into small micropayments, to speed up their uptake by low-income households (Hollanders, 2020; Mergulhao et al., 2023; Tay et al., 2022). Crowdfunding also focuses funds on renewable projects through the small donations, expanding the scale of clean-energy investment (Menyeh and Acheampong, 2024). AI scores and funding credits items such as solar pumps, and peer-to-peer energy trading and micro-payment in off-grid microgrids can be enhanced by blockchain (Mhlanga, 2022). It has been proven that PAYG solutions have the potential to generate credit histories furthering greater inclusion (Ajwang, 2018). Parametric microinsurance also improves the stability of repayment of energy loans, which will promote rural lending (Lu et al., 2022). Outside the family, FinTech assists energy startups and cooperatives to overcome collateral and risk barriers (Bani Atta, 2025; Care et al., 2025). Overall, FinTech reduces expenses and access, directing capital to underserved customers and innovators, improving SDG7, and further sections cover how ESG and responsible finance will help to ensure that inclusion will translate to sustainable energy results (Tan et al., 2024).

2.2. ESG Integration in Finance

ESG integration refers to the factual application of the environment, social, and governance variables to investment analysis and investment decisions, extending beyond the conventional risk-return analysis into tools like emissions, resource utilization, labour policies, community engagement, board diversity, and disclosure (de Souza Barbosa et al., 2023). Environmental indicators include the intensity of greenhouse

gases and renewable energy; social indicators include employee welfare, equity, privacy and community relations; governance indicators are related to leadership, ethics, rights of shareholders and compliance. There are investors who measure ESG through third-party metrics (e.g. MSCI, Sustainalytics) or company-specific metrics based on standards such as GRI and SASB. Some of the most frequently used E/S/G metrics in energy finance are carbon intensity, stranded-asset exposure, access gains and local jobs, and anti-corruption procurement protection. Net-zero commitments are becoming more popular, prompting banks and institutional investors to incorporate ESG due diligence, in which they are redirecting capital out of fossil assets into renewables and efficiency (Kreander et al., 2025; Verma and Shroff, 2025; Galeone et al., 2024; Zaid et al., 2025). Green bond and sustainability-linked loans are examples of instruments that condition the financing terms on the energy-sustainability performance, reducing the capital cost of high-ESG firms, and strengthening the SDG7 development (Huang et al., 2025). FinTech enhances the level of ESG integration: blockchain and IoT allow audible, real-time monitoring of environmental emissions and supply-chain activities, analytics and AI confirm disclosures and warn about threats (Rezaee and Tuo, 2019; Wang et al., 2024; Olanrewaju et al., 2024; Bhandari et al., 2025; Trotta et al., 2024). The Chinese experience indicates that FinTech development has the potential to reduce the obstacles in financing and improve ESG disclosure to increase the environmental and social performance of firms (Ding et al., 2024). There are still ongoing issues like metric standardization and ESG performance of FinTech providers themselves, yet the integrative push of ESG and digital technology is shifting more inclusive and affordable capital to clean energy.

2.3. Energy Sustainability and SDG7

The SDG7 energy sustainability pillar is based on three pillars which are interlocking, including universal access, increasing lifecycle of renewable energy, and rapid energy efficiency (Fura and Skrzypek, 2025). Access does not only mean electricity and clean cooking/heating, but the quality of service, reliability, affordable, safe, and capable of meeting development needs, which is defined by a multi-tiers structure of the World Bank (Shyu, 2024). The renewable share refers to the ratio of the final energy use satisfied by solar, wind, hydro, geothermal and modern bioenergy, where the proportions of renewable are greater, indicating a cleaner mix and lower externalities on the environment (Estevao and Lopes, 2024). Efficiency is aimed at doing more by using less, which involves reducing energy intensity through better construction, appliances, and industrial technologies, which is usually measured by energy use per unit of GDP (Chen et al., 2024). SDG7 realizes these concepts by Targets 7.1-7.3 (universal modern energy access, increasing the portion of renewables, and doubling the rate of efficiency improvement around the globe by 2030), with 7.A-7.B on cooperation with the rest of the world and investment in infrastructure.

The poorest and the middle-income nations have the most difficult route to the targets. The population growth is counterbalancing the benefits of electrification in some areas of Africa and South Asia, leaving the absolute number of people without electricity at a still high level (Al Humdan et al., 2025). The lack of long-term financing, high last-mile costs, political instability, and institutional capacity constraints are the factors that limit clean energy justice, clean energy justice, therefore, depends on the enabling conditions that include logistics performance, stable governance and inclusive finance (Al Humdan et al., 2025). However, the motivation towards renewables and efficiency in the MENA region has traditionally been subsidized through fossil fuels, but recent reforms, green-finance programs, and vehicles like green banks and FinTech sandboxes are shifting the capital towards solar and wind (Matallah et al., 2023; Meero et al., 2025). The full potential and constraints of decentralized solutions can be seen in emerging Asia: tens of millions of solar-home systems and clean cookstoves have brought access, but are difficult to scale to dense urban settlements and long-term maintenance (Tay et al., 2022).

The common impediments across LMICs fall in four domains. To begin with, financing barriers such as high perceived risk and currency volatility and small, scattered projects are impediments to investing in mini-grids and efficiency retrofits; in this case, digital aggregation and data-driven de-risking through FinTech can be used. Second, the cost of grid extensions is increased by infrastructure and technology deficits and the off-grid distribution and service networks are overstrained, weak digital connectivity in its own right has been shown to impede mobile payments required to purchase energy services and inadequate local technical capacity compromises system maintenance. Third, both energy and digital-finance inclusion can be blunt by policy or regulatory frictions: unclear renewable frameworks, bureaucracy, unstable subsidies or price controls and strict KYC rules. Fourth social and cultural determinants, including established cooking behaviors and suspicion of new technologies and gender differences in financial and digital access point to community involvement and specific inclusion images and tactics.

In combination, these barriers justify slow SDG7 improvements even with the help of technologies. Since SDG7 is interconnected with poverty alleviation, health, and climate action, cross-sector collaboration is an essential requirement (Falcone, 2023; Isah et al., 2023; Raman et al., 2025). FinTech and ESG finance are cross-cutting enables: the former expands accessibility, reduces transactional costs, and mobilizes small-ticket capitals; the latter internalizes sustainability in the mandate and corporate governance of investment and directs money toward clean energy (Drago et al., 2025). More importantly, inclusion should go hand in hand with a more sustainable supply: as emerging economies experience, financial inclusion, but not its combination with increased renewable uptake, can exert an increasing ecological footprint by increasing energy use (Kaplan et al., 2024). The strategic implication is obvious, digital financial inclusion and ESG-appropriate investment do not work in isolation, and there is a multiplier between them with the assistance of on-the-ground energy efforts that will enhance universal, affordable, and clean energy transitions.

2.4. Linking FinTech Solutions to Green Finance and ESG Compliance

Financial technology (FinTech) has advanced the reach of green finance by promoting automation, data integrity, and transparency

for green finance instruments including green bonds, green and sustainability-linked loans, and climate funds (Fu et al., 2023; Palmaccio et al., 2023). Automated IoT-linked emissions monitoring and reporting systems and smart contracts on blockchain technology adjust sustainability-linked loans' interest rates based on real-time data on energy outputs, avoided emissions, and performance sustainability goals (Huang et al., 2025; Rezaee and Tuo, 2019; Christodoulou et al., 2023). Green crowdfunding and P2P systems publish ESG-compliant impact reports that contain reductions in CO2 emissions and installed kilowatts which attracts small scale investors to wind, solar, and energy efficiency projects (Liu et al., 2025; Gai et al., 2025). Finally, there is work by Duran and Tierney (2023), Alhanatleh et al. (2024), and Huang et al. (2025) that demonstrates how AI and sophisticated analytics enable banks and fund managers to focus on green investments by calculating the carbon footprint of investment portfolios and splitting them into high-carbon and low-carbon investments. Furthermore, the extension and dissemination of the adoption of ESG principles in supply chain and trade finance is proliferated by FinTech. Using these tools allows for multiple synchronization efforts across micro, meso, and macro levels. This includes promoting individual and joint community access at the grassroots, streamlining community efforts into fundable initiatives, and improving market-level clarity. These improvements ensure that the digital tools of inclusion advance toward transparent, discerning, and socially responsible investments, propelling the achievement of the SDG7 targets highlighted by Chatzinikolaou and Vlados (2025) and Xu et al. (2023).

3. REVIEW OF LITERATURE AND METHODOLOGY

This literature review seeks to capture the study trends pertaining to FinTech, digitally inclusive finance, integrated ESG and renewable energy (SDG7) during the period of 2018 to the first half of 2025. For this purpose, we relied on multiple academic databases, chiefly Scopus and Web of Science, supplemented by Google Scholar to widen the net. For this purpose, we conducted systematic Boolean keyword searches designed to the review parameters. For each of the thematic areas we deployed multiple synonyms and associated terms as outlined in Table 1. We focused on peer-reviewed journal articles which include original research, review articles, and policy papers, and ensured that the articles all came from Scopus- and Web of Science- indexed journals to meet the requirements of our review. Most of the time, conference papers and preprints were set aside except when they provided specifically pertinent information that had not yet been addressed in journal literature. The first search yielded approx. 317 results. Running the deduplication exercise and subsequent title/abstract screening, we used relevance to refine the results to approximately 124 candidate articles. In defining the inclusion criteria, we particularly sought for works that explicitly map the links between at least 2 of our 3 pillars: (i) FinTech/digital inclusion, (ii) ESG/green finance, (iii) energy/SDG7. Within this scope, studies that only cover FinTech and general financial inclusion (without addressing the sustainability dimension) or studies that focus solely on green finance and energy (without incorporating digital finance) were excluded, since our primary interest lies at the convergence of these areas. Since both FinTech and sustainable finance evolve rapidly, we also focused on more recent literature (published from 2018 onwards) to identify the most recent trends. This refined the selection to 45 core articles which were subject to an in-depth review. In this review, the PRISMA procedure was followed and we provide here a simplified flow diagram. Of 317 initial hits, 193 were excluded (not relevant or out of scope); 79 full texts were reviewed, and 45 were included for synthesis. For the organization of the insights, the literature was thematically grouped. This resulted in three broad thematic clusters:

(1) Impact studies: Empirical studies that focus on the effect of digital financial inclusion or the development of FinTech on environmental and energy outcomes (e.g., studies which utilize country-level data to assess the relationship between digital finance and investments in renewable energy or emissions).
(2) Mechanism and case studies: Analyses of particular FinTech applications in the energy context (e.g. case studies on pay-as-you-go solar, blockchain pilots, green crowdfunding, and crowdfunding and ESG data platforms).
(3) Policy and conceptual papers: Frameworks and discussions on FinTech and energy integration's opportunities and challenges, which usually involve thought leadership or theoretical frameworks lacking primary data analysis.

Table 1: Thematic keyword map for literature search (2018–2025)

Theme	Refined Keywords Used
FinTech and digital financial inclusion	FinTech, digital finance, financial inclusion, mobile money, mobile banking, digital payment, crowdfunding, peer-to-peer lending, blockchain finance, AI credit scoring, InsurTech, regtech, digital banking, unbanked, underbanked, mobile microfinance
ESG integration and sustainable finance	ESG investing, ESG integration, sustainable finance, green finance, green bonds, climate finance, responsible investment, SRI (socially responsible investment), impact investing, environmental disclosure, CSR (corporate social responsibility) in finance, green FinTech, Greentech, sustainability reporting
Energy access and SDG7	Energy access, clean energy access, electricity access, clean cooking, SDG7, sustainable energy, affordable energy, renewable energy, energy transition, energy efficiency, modern energy services, energy poverty, energy justice, off-grid energy, microgrid
Intersection of FinTech/ESG/Energy	Digital financial inclusion AND energy access, FinTech AND renewable energy, digital finance AND clean energy, mobile money AND solar, crowdfunding AND renewable energy, blockchain AND energy trading, green digital finance, FinTech AND climate change, financial inclusion AND sustainable development, fintech AND SDGs, ESG AND FinTech, ESG AND energy investment, green FinTech AND SDG7

Keywords were combined and adjusted iteratively to ensure comprehensive coverage of relevant literature. Boolean operators (AND, OR) and wildcards were used to capture variations (e.g., "financ* inclusion" to get financial/finance inclusion)

Table 2 summarizes representative studies for each of the categories outlined above. In extracting the relevant data, we analyzed contextual (countries or regions), methodological (qualitative case study, econometric analysis, and others), and significant contributions or conclusions of each study. This analysis enabled us to understand the extent to which individual works

Table 2: Summary of key studies on FinTech, ESG, and SDG7 themes

Authors, Year	Context and Data	Methodology	Key Findings/Conclusions
Al Humdan et al. (2025)	70 developing countries; 2000–2018 data	2SLS IV regression; GMM and quantile regressions	The growth of Digital Financial Services has had a positive impact on "clean energy justice" (a combination of access and equity considerations). Moreover, finds that energy access outcomes were also positively influenced by improved performance of logistics (infrastructure) and political stability. Suggesting energy access plans consider investments in digital payment systems and stable governance, the author illustrates the need for policymakers to ensure that the distribution of clean energy is equitable—that is, it should go beyond mere availability.
Ding et al. (2025)	China; firm-level data on New Energy Vehicle (NEV) companies; FinTech development index	Panel regression; robustness checks with instrumental vars	Advancements in FinTech considerably enhance corporate ESG ratings within the NEV (electric vehicle) sector. This is primarily because FinTech alleviates financing constraints and increases the environmental information disclosure practices of companies. The impact is most pronounced among smaller, technology-driven firms. It is thus determined that FinTech promotes corporate sustainability by providing more flexible financing for green initiatives and improving green finance access. Proposed policy initiatives embrace the positive integration of FinTech within corporate ESG frameworks.
Kaplan et al. (2024)	20 emerging economies; data 2007–2019	Panel GMM regression; interaction terms between inclusion, innovation, renewables	Financial inclusion and technological innovation on their own are associated with higher CO_2 emissions (greater access seems to translate to higher energy consumption). However, consumption of renewable energy mitigated this effect. More importantly, the interactions (Inclusion×Renewables, Innovation×Renewables) led to lower emissions, indicating that inclusion/innovation are only eco-friendly in combination with the use of renewable energy. Policy implication: Targeting inclusive finance to clean energy investments will guarantee green results.
Menyeh and Acheampong (2024)	Ghana (survey of investors and platform data)	Mixed methods: investor surveys; project performance analysis	Crowdfunding has started being one of the alternative financing methods for projects related to renewable energy in emerging markets. Investors are financially and impact motivated. One major finding in this case is that investors, due to uncertainty in the policies driving evaluation of renewable energy projects, perceive such projects as having a greater risk and a lower return alternative as opposed to other investment prospects. However, as long as there is trust, investors will still be interested in earning renewables which are also associated with reasonable returns. The authors suggest government guarantees or co-funding to remedy the unfairness that comes with green crowdfunded projects.
Galeone et al. (2024)	European banks; data on FinTech adoption and ESG scores (2015–2021)	Empirical analysis (panel regression); technology adoption models	Demonstrates significant associations of social pressures and peer pressures including ESG and FinTech adoption by banking institutions and peer influence the adoption of FinTech by banking institutions correlates strongly with social and ESG influence. Banks with greater ESG commitments are more likely to invest in transformative FinTech. Such relations correlate to an institution's finances modernization potential of an institution toward the ESG benchmark. It shows the considerable strategic interdependence of FinTech and ESG in a bank's operational structure where each element supports the realization of the other's goals through intensive digitalization.
Jain and Gupta (2024)	Global, conceptual paper on FinTech's alignment with SDGs	Literature review	FinTech promotes financial inclusion and inequity reduction by developing digitized innovative platforms which widen access to sustainable financial services, further integrating green financing technologies with the SDG targets completion.
Kumiega (2024)	Environmental credit markets	Case-based analysis	Financial technology innovations, especially in the blockchain technology and digital registries, enhance how the environment is governed and market instruments are more sustainable by enabling credit environmental trading to become more transparent, traceable and efficient.
Trotta et al. (2024)	Global literature base	Bibliometric analysis	This paper presents major bibliometric clusters concerning FinTech-ESG nexus and defines the topics undergoing changes in these clusters, such as green digital finance, ESG data analytics, and regulatory technology (RegTech) in addition to indicating areas of interdisciplinary research opportunities.
Gupta and Chaudhary (2024)	Circular economy and ESG context	Conceptual framework with AI/ML examples	It is observed that the combination of FinTech with AI/ML technologies is critical for automating the metrics needed to measure/report the sustainability of corporate activities, thus improving sustainability reporting transparency and optimizing resource use for circular economy and ESG compliance.
Thakkar and Bhuyan (2024)	Cross-country panel data	Empirical econometric analysis	Research shows FinTech adoption increases progress towards the SDGs., probably due to improved access to finance, greater efficiencies, and support for inclusive economic growth in the developing world.

(Contd...)

Table 2: ***(Continued)***

Authors, Year	Context and Data	Methodology	Key Findings/Conclusions
Alqudah et al. (2024)	ESG technologies literature	Cluster-based bibliometric analysis	The review presents ESG technologies according to thematic groups and how the automation of ESG compliance, the development of green investment platforms, and stakeholder involvement in active sustainable corporate activities are being enabled with greater ease through FinTech.
Shala and Berisha (2024)	Case studies from Europe	Comparative qualitative analysis	Financial technology mobile payments, peer-to-peer lending, and digital identity verification are highly beneficial in terms of accessibility, transparency, and social inclusion, particularly among the Europeans who are underbanked, and, therefore, promote the beneficial social effects of the ESG criteria.
Fatima and Carè (2024)	Global bibliometric review	Bibliometric mapping	Based on the bibliometric review, DeFi and FinTech are underlying technologies to fulfill SDGs through decentralizing the financial service, impact investment innovation, and contributing to clear sustainability reporting systems.
Jain (2024)	Global technological perspective	Narrative review	The promising technologies of the Fourth Industrial Revolution, such as artificial intelligence, blockchain, and Financial Technologies (FinTech) help the Sustainable Development Goals (SDGs) to be achieved due to the opportunities of real-time monitoring, efficient service delivery, and active citizen engagement in government. The integration of such technologies into the global governance and sustainability efforts opens up deep innovative breakthroughs.
Klimontowicz et al. (2024)	Global academic literature	Systematic literature review	A systematic review demonstrates that there is significant literature on the implications that FinTech holds on the progress of the SDGs specifically with regard to finance inclusion and digital sustainability but indicates that longitudinal investigations of the long-term impacts should be conducted.
Verma et al. (2023)	India-focused	Qualitative synthesis	Within the Indian context, the study has established the FinTech industry as a partner to the SDGs as especially effective in increasing the reach of inclusive finance, building digital access, improving gender equality, and empowering the growth of small enterprises.
Chatterjee et al. (2023)	India, policy and market trends	Mixed-methods review	The FinTech evolution in India is indicative of exceptional progress in the adoption and integration into the sustainable development paradigm, as the regulatory and consumer adaptation factors and a fresh ecosystem have been central to the accretion of good outcomes.
Tay et al. (2022)	Global review, focus on developing Asia; 56 articles (2015–2021)	Systematic literature review	Digital financial inclusion advances many Sustainable Development Goals (SDGs), including SDG7. Mobile payments and fintech services like pay-as-you-go models allow low-income households in Africa and Asia to access and afford modern energy services. However, there are still considerable gender and rural-urban divides in digital access which suggests that the infrastructure and financial literacy needed to achieve the full benefits of inclusion still requires attention.
Liu et al. (2022)	E7 emerging economies (e.g., China, India, Brazil); 2013–2018 panel data	Econometric panel analysis (FE, Random effects); Green finance index, FinTech index	Positive impacts on energy efficiency were driven financially by inclusion, green finance, and the advancement of FinTech. Of the three, green finance most positively impacted efficiency. Although limited by unequal financial infrastructures, the impacts of FinTech and inclusion were still positive albeit smaller. There are suggestions on strengthening FinTech-augmented green bonds and re-evaluating FinTech payment frameworks to further advance energy efficiency objectives.
Mhlanga (2022)	Sub-Saharan Africa focus; secondary data from IMF, World Bank, UN	Qualitative document analysis (policy review)	Protective measures for climate-related losses, such as mobile insurance, recasts the perception of FinTech as a facilitator of climate risk management for mobile transfers and disaster recoupment. Shown as a cognitive dissonance, climate change, through disasters, can aggravate the gap of the financially excluded. Financial inclusion, with the risk of climate change impact, must integrate climate risk.
Du et al. (2022)	Chinese listed firms	Quantitative analysis, panel data regression	Through alleviating internal financing constraints and exploiting government fiscal incentives, FinTech has a positive effect on corporate ESG performance. Evidence from Chinese firms reports better environmental disclosures and social responsibility.
Hoang et al. (2022)	Asia-Pacific countries	Descriptive review	Evidence indicates that FinTech fosters advances in eco-innovation, expands the scope of digital service access, promotes green entrepreneurial activities, and generally supports the Sustainable Development Goals, especially in rapidly digitizing Asia-Pacific countries.

converged or diverged. Prior to the findings, Table 1 provides a map of the refined search keywords pertaining to each thematic area of the research, which we defend below. These keywords were mostly employed in conjunction, such as "digital financial inclusion AND energy access", "FinTech AND renewable energy investment", or "green finance AND blockchain AND energy".

With the foundation of the search strategy and thematic framework, an integrated review of the primary literature was conducted, focusing on the findings from distant but important studies, and is documented in Table 2. Table 2 represents a summary of a few selected studies which will serve as the basis of the follow narrative synthesis.

4. THEMATIC SYNTHESIS OF FINDINGS

The promotion of clean and affordable energy through digital financial inclusion via FinTech is increasingly framed as a mechanism for achieving sustainable development goals. While Tay et al. (2022) and Mhlanga (2022), synthesizing review and policy analyses, argue that digital payments, credit, and insurance delivery to the unbanked empowers investments in fundamental needs, particularly with regard to modern energy and electricity, as a result of lowered transaction costs and the provision of pre-paid, smaller-amount purchases. For instance, Tay et al. (2022) directly relates various digital finance tools (mobile payments, digital loans) to targets within the SDGs and demonstrates that for SDG7, prepaid digitized instruments, in the off-grid context, triggered the uptake of solar lights and efficient stoves in low-income households. Hence, convergent case studies from different regions reiterate the "energy–finance nexus": Achievement of SDG8/9 through financial inclusion and the ability to pay in turn drive energy access under SDG7. This sets in motion positive development cycles.

Empirical studies build on this narrative showing that impacts are conditional. Kaplan et al. (2024) report that financially included individuals (measured by having a bank account and credit) are likely to be associated with higher CO_2 emissions in emerging economies since rising purchasing power translates to energy demand that is met by fossil fuel energy supplies. Pairing financial inclusion with a higher share of renewable energy, however, reverses this trend, resulting in emissions reductions. In a similar vein, Liu et al. (2022) shows that financial inclusion and FinTech development are positively associated with improved energy efficiency in E7 countries, although the influence of green finance is more pronounced which likely stems from the way the capital is structured (being directed toward more energy-efficient and productive uses as opposed to energy consumption). Overall, there are positive implications: new digital financing mechanisms are enabling more substantial shifts to cleaner fuels and more efficient technologies, and there is a high possibility of decoupling growth from energy use, provided there is a green supply.

There is additional evidence demonstrating a link between the penetration of FinTech and the deployment of green technology. In China, areas with more advanced digital ecosystems in finance have experienced a more rapid development of renewable energy and renewable energy capacity because FinTech facilitates the overcoming of information asymmetry and the lowering of transaction costs that finance renewables (Cao et al., 2021; Yu et al., 2022). In Sub-Saharan Africa, the situation is analogous; the proliferation of mobile money provided the critical infrastructure for off-grid solar business models, particularly for Pay-As-You-Go (PAYG) systems, because it offered reliable, inexpensive payment collection systems. Hence, whilst FinTech infrastructure has the potential for financing, it is typically more the case in practice that FinTech provides the payment, information, and platform systems upon which distributed energy companies can enhance their scope.

The literature has established that financing with a greater emphasis on sustainability results in superior environmental outcomes, interacting positively with digitalization. Al Humdan et al. (2025) describe digital finance as a possible driver of "clean energy justice" in the context of expanding equitable access, especially when coupled with the right policies and governance frameworks. On the firm level, Ding et al. (2025) assess the influence of FinTech on ESG practice advancements by alleviating the financing constraints tied to environmental disclosure and thus improving ESG performance in China's EV sector. Similarly, Hasan et al. (2025) find a positive correlation between higher ESG score and the shift towards greater digitalization of bank services, supportive of Galeone et al. (2024) on the bidirectional relationship between FinTech adoption and ESG focus. However, the literature also identifies several risks, including the possible expansion of fossil consumption with inclusion (Kaplan et al., 2024), distributional constraints by gender and geography (Tay et al., 2022), predatory and potentially abusive practices around the decentralized assets of provisioned services (Mhlanga, 2022), the inability to reliably measure and report on the ESG performance of digitized micro-transactions (Galeone et al., 2024), and limited and crude cross-country proxies to measure and assess advanced ESG frameworks. Therefore, the policy implication is to strive for integration, that is, the alignment of financial inclusion with renewable energy initiatives and strong ESG policies to ensure digital financing results in meaningful progress towards SDG 7.

The unique energy system and fossil fuel consumption practices in the Middle East and the Gulf constitutes a relatively low level of financial inclusion and digital monetization especially among migrant workers and for the last few decades digitalization and the growth of the FinTech sector has been correlated with improved environmental outcomes (Ibrahim et al., 2024). In the Middle East, the Gulf states, particularly the sovereign-financed, digitally enabled sector banks and green-financing enterprises of the UAE and Saudi Arabia, are capturing a growing block of investment in the solar energy and efficiency financing market. However, the legacy system of subsidies and extremely high energy consumption per capita are fundamental barriers that cannot be overcome by FinTech alone. The FinTech-enabled cash transfers undertaken in Jordan to subsidize energy demonstrate how FinTech systems can be used in closing price distortion gaps in economic reforms. The lack of integrated FinTech systems and structures in other parts of the world, especially the Asia continent, demonstrates other energy and FinTech systems, as in South Asia, with digital systems driving growth in microfinance and solar PUB systems, as with IDCOL in Bangladesh and the off-grid solar empowered policy in India.

East Asia has focused on the integration of large-scale green finance and digital ecosystems: in China, consumer apps (e.g., Ant Forest) integrate gamified carbon tracking and carbon credits, while FinTech innovations connect and automate investments in carbon market (Wang et al., 2024). Southeast Asia presents different dynamics. While digital lending is expanding in the Indonesia and Vietnam with some research focused on solar and efficiency programs, context-specific research is weak and should be used to inform more complex and contextually nuanced research to avoid making simplistic comparisons between China and Pakistan. Literature highlights the importance of collaboration

across multiple sectors like finance, energy, technology, and policy. Within these literature streams, co-investment in digitized energy infrastructure (Al Humdan et al., 2025), policy frameworks for renewable crowdfunding (Menyeh and Acheampong, 2024), and the co-strategizing of ESG bank policies around digital transformation for maximum impact (Galeone et al., 2024) are recurrent themes. There is general agreement that the positive role of FinTech is as an accelerant and not a complete solution. Core collaborations, FinTech friendly regulations, and training initiatives will enhance FinTech focused outcomes. The regional record is at best, partially complete. Evidence of ESG FinTech integration is directing funds towards cleaner energy and improving access. However, equitable and sustainable outcomes are largely a product of policy frameworks, in particular Middle East subsidy reforms and Asian governance, market maturity, and infrastructure gaps. Key research gaps are the micro behavior, the long-term effects in lower-income countries, and detailed country analysis that will drive specific country strategies.

5. RESEARCH GAPS AND FUTURE DIRECTIONS

There has been progress in understanding the FinTech-ESG-SDG7 connections; however, there are still notable gaps. Firstly, the micro-level behavioral aspects remain largely unexplored. For example, the evidence suggests that PAYG models greatly facilitate the acquisition of clean energy technologies, however, there is limited evidence on the post-repayment persistence of PAYG clients, maintenance, and follow-on investments towards efficient appliances. Longitudinal studies and randomized controlled trials (RCTs) on the energy default, consumption, and welfare frameworks that fit within the intertemporal choice and technology adoption frameworks, and that monitor PAYG clients are promising. For example, collaborating with PAYG providers to randomize financial literacy nudge, utilization feedback and incremental credit could provide interesting insights. Complementary behavioral studies, which manipulate the reward and real-time feedback, could test the hypothesis that digital inclusion has a direct effect on the formation of sustainable and efficient behavioral patterns, and that there will be some reward satiation.

The effective adoption of ESG in developing-country financial systems needs context-sensitive inquiries on how FinTech would advance disclosure, assurance, and governance concerning SMEs. For instance, how feasible is it to customize ESG indicators according to local institutional logics, and how to utilize digital rails, such as e-KYC or blockchain, to enhance the flow of green loans? Engaging diffusion and institutional theories, comparative qualitative case studies can be designed to explore the green bond initiative in Kenya or value-based intermediation in Malaysia, alongside the motivations and constraints obtained through multi-country interviews with bankers, fintech founders, and regulators. Such studies can relate to the friction and driver constructs. To explore the depth of sustainable finance and the flow of credit to renewable-energy SMEs, quasi-experimental approaches may be adopted to study the FinTech marginal effect in otherwise comparable economies with asymmetries in mobile-money usage. In the meantime, it is important to examine the extent to which digital tools enhance ESG governance on complex supply chain and portfolio lending.

The mixed-methods approach is also imperative to examine the social inclusion aspect of energy transitions. Energy poverty extends beyond kilowatt-hours to affordability, safety, and capability: studies should test whether digital energy finance reaches ultra-poor, low-literacy, rural, or women-headed households on equitable terms (Tay et al., 2022; Mhlanga, 2022). Surveys, focus groups, and administrative-data analysis can surface participation biases, debt burdens, and unintended consequences, informing inclusive-innovation responses (e.g., community intermediaries, voice-based interfaces, local-language apps, or grant-backed tiers for those unable to meet even micropayment schedules). Forward-looking work should also examine system-level effects as FinTech diffuses: agent-based and game-theoretic models can explore how peer-to-peer trading, prosumers, and off-grid finance reshape grid stability, tariff design, and utility strategies across regulatory regimes, drawing lessons from mature prosumer markets for jurisdictions where such models are nascent.

Last but not least, it is necessary to include climate risk in digital financial services, and methodological innovation is needed. Micro- and parametric insurance offered via mobile means to solar home systems or mini-grids may enhance the resilience to extreme weather, but the literature on the uptake and effectiveness is limited; pilots need to explore how insurance/savings bundles affect downtime, repayment resilience and recovery speed. At the macro level, the field should apply big data and artificial intelligence, which involves the use of the transaction trails, smart meter streams, satellite images, and disclosures mined texts all to predict the adoption and the default and the scale effect without compromising privacy in safe data sharing. Theorizing digitalization in sustainable transitions through interdisciplinary partnerships with development economics, finance, energy engineering, behavioral science, and data science will enrich the theorization of the FinTech/ESG integration to guarantee that the SDG7 results of the and-not-or interactions are meaningful, fair, and sustainable.

6. CONCLUSION

The integration of FinTech with digital financial inclusion and finance integrating the principles of ESG intersects with the routes to achieving Sustainable Development Goal 7. This review explores how mobile payments, digital lending, and blockchain technologies are expanding access to capital and energy services to previously underserved consumers. This disinvestment from fossil fuels to renewables and energy efficiency principally guided by the adoption of digital tools and analytics coupled with ESG principles accelerates the effect. However, the advantages are conditional. Inclusion that occurs without expansion of associated clean supply can increase emissions. FinTech and energy services are still digital solutions that are poorly designed, which increase the risk of deepening the gender, rural, and attainment literacy divides. Thus, the effective scaling of these innovations will hinge

upon enabling regulation and multi-stakeholder coordination among FinTech innovators, energy providers, oversight entities, and the affected populations. In response to the core questions, we find that FinTech is instrumental in decreasing affordability and reach barriers PAYG and digital microfinance empower low-income users to clean energy and fuel local enterprise. ESG integration guides disinvestment from presents to sustainable assets, while digital tools (e.g., tokenized green bonds and AI-enhanced assessments) strengthen engagement and data quality around FinTech, and operational alignment with ESG remains.

In the case of targeted subsidy delivery, like mobile vouchers for clean cooking, the synergy between FinTech and ESG is apparent, although benefits might be hindered by the slow pace of regulation, low digital literacy, and privacy issues, which are barriers that can be addressed through policy adjustments and digital literacy training. We contend that the digitalization dividend witnessed in the world post-COVID-19 offers an inflection point. The integration of FinTech and ESG advancing harmoniously can render growth considerably greener (SDG8), shift the focus of innovation to social missions (SDG9), and enhance the effectiveness of partnerships (SDG17) overall. For this, a practical set of guidelines would include the strategic investment in digital and energy infrastructure, the designing of rule frameworks, the innovation of business models, and consumer protection. When pursued in this sequence, a virtuous circle is established, where digital inclusion promotes energy inclusion, which in turn, strengthens the sustainability of the energy system and the finances of the system. To achieve this, multidisciplinary and multifactor collaboration is non-negotiable. Academics need to develop integrated models of finance and energy and provide the type of evidence needed by ministries of finance and energy. Community co-design by practitioners, collaboration of environment experts for policy regulation, and mainstreaming digital finance with energy access and climate portfolios by development finance institutions is critical. Innovative finance will be as fundamental as the solar panels and grids to achieving SDG7 by 2030. With the integration of the fintech and ESG ecosystems, we can achieve a more inclusive and sustainable energy future.

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