

## ***The Role of Climate Fintech Companies in Reducing Carbon Emissions to Achieve Sustainable Development Goal 13***

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### **Abstract**

This study aims to analyze the role of climate financial technology (climate fintech) companies in reducing carbon emissions, thereby contributing to the achievement of Sustainable Development Goal 13. The study adopts an analytical approach by tracking the evolution of global carbon emissions from 1990 to 2022, identifying the main causes and the countries most responsible for their increase. It also examines the key technologies used by climate fintech companies—such as artificial intelligence, blockchain, and environmental data analytics.

The study analyzes several core indicators, including the volume of climate fintech funding between 2021 and 2023 and its distribution across leading countries in this sector. The findings reveal a positive relationship between the development of climate fintech and the achievement of climate goals, whether through facilitating green finance or providing innovative digital solutions for monitoring and reducing emissions. The study concludes that climate fintech companies play a central role in the transition toward a low-carbon economy and contribute effectively to achieving carbon neutrality by 2050, provided they are supported with appropriate regulations, enhanced transparency, and the availability of specialized expertise.

**Keywords:** Climate FinTech; Carbon Emissions; Sustainable Development Goal 13 (SDG 13); Green Finance.

**Jel Classification Codes :** Q01 ; Q54 ; O33.

## **I. Introduction :**

The twentieth century and the early decades of the twenty-first century have witnessed a troubling development in global carbon emission patterns. Available data indicates a massive increase in carbon dioxide emissions from fossil fuel sources and industrial processes. According to the latest reports from the International Energy Agency (IEA) and the Global Carbon Project, the world experienced an unprecedented rise in total carbon dioxide emissions, reaching a record high of over 37.4 billion tons in 2024—an increase of 0.8% compared to the previous year (Global Carbon Project, 2024; International Energy Agency, 2025).

This upward trend reflects the compounded impact of rapid economic growth in emerging economies and the increasing reliance on fossil fuels in the industrial, transportation, and electricity sectors. Statistics show that global emissions have increased more than 182-fold since the beginning of the Industrial Revolution in the mid-19th century (Vigna et al., 2024) and have risen by more than 60% since 1990 alone (Statista, 2025). This notable acceleration in emission rates poses a fundamental challenge to international efforts aimed at containing global warming and mitigating its long-term environmental, social, and economic consequences.

The climate implications of this development go beyond rising global temperatures to include drastic changes in weather patterns, sea level rise, and an increase in the frequency and severity of extreme climate events. These changes also negatively affect ecosystems, biodiversity, and global food security. In this context, there is an urgent need to develop comprehensive and multidimensional strategies to reduce carbon emissions and promote the transition toward a low-carbon economy.

The steady increase in greenhouse gas concentrations in the atmosphere, and the resulting complex climate, environmental, economic, and social implications, has become one of the most intricate challenges facing the international community in the 21st century. Successive scientific reports issued by the Intergovernmental Panel on Climate Change (IPCC) and specialized environmental organizations strongly affirm the urgent need for a comprehensive and integrated approach to addressing this escalating climate crisis (Intergovernmental Panel on Climate Change, 2023).

In this critical context, the international arena has witnessed a broad mobilization of institutional, governmental, academic, and technological efforts aimed at formulating radical strategies capable of curbing carbon emissions and achieving a transition toward a sustainable and low-carbon development model. These efforts have materialized through a number of ambitious international initiatives, including the 2015 Paris Climate Agreement and the United Nations Sustainable Development Goal 13 (SDG 13), which focuses on “climate action” and the need to take urgent measures to combat climate change and its impacts, in addition to the Nationally Determined Contributions (NDCs) through which countries commit to achieving specific emission reduction targets by 2030 as a key step toward carbon neutrality by mid-century.

In the search for the most effective mechanisms and tools to achieve these ambitious goals, there is a growing consensus among both advanced and emerging economies that digital transformation and technological innovation constitute two central pillars of the contemporary climate solution framework (Dou & Gao, 2023; Liu et al., 2024; Wang & Li, 2024; Xue et al., 2022; Zhang, 2024). This approach has taken shape in the emergence of a new, specialized sector known as “Climate Financial Technology” (Climate FinTech), which combines innovative financial tools

and advanced digital technologies to address climate challenges from an integrated economic and technical perspective.

This emerging sector, which is witnessing rapid growth in investments and initiatives globally, seeks to develop innovative solutions aimed at addressing "carbon leakage," improving the efficiency of carbon pricing mechanisms, developing carbon credit markets, financing renewable energy and clean technology projects, and enhancing transparency and accountability in tracking and monitoring emissions across multiple levels.

The complex and multidimensional nature of this intersection between financial technology and climate action raises essential questions about the effectiveness of the proposed mechanisms, their ability to deliver the desired impact in reducing carbon emissions, the challenges and opportunities related to their application in diverse economic and geographical contexts, and the future scalability and development of such solutions.

In light of these intertwined considerations, this study aims at answering the central research question: How does climate fintech companies contribute to achieving carbon emission reduction goals and accelerating the transition toward a sustainable and low-carbon economy?

The main objective of this study is to analyze and understand the current state of climate change around the world and the extent of countries' contributions to it. It also aims to examine the role of green financial technology in addressing this issue, considering it one of the most impactful solutions adopted during this period. The study seeks to assess the extent to which this technology can contribute to achieving the set goal of zero emissions by the year 2050.

The importance of this research lies in its focus on a critical intersection between technological development and the urgent need for climate action, making it directly relevant to policymakers, investors, academics, and those concerned with environmental and economic sustainability alike.

The study is organized into six sections. After the introduction, the literature review presents previous studies on climate and fintech. Section III examines the causes and trends of carbon emissions. Section IV defines climate fintech and its role in emission reduction. Section V discusses its importance in climate protection. Section VI analyzes market size and key challenges. The Conclusion summarizes findings and offers recommendations.

## **II. Literature Review**

The intersection of financial technology (fintech) and climate action has emerged as a critical area of research, particularly in the context of achieving Sustainable Development Goal 13 (climate action) and global carbon emission reduction targets. Recent empirical evidence consistently demonstrates that fintech development significantly contributes to carbon emission reduction across various geographical contexts and analytical frameworks. Tao et al. (2025) provide compelling firm-level evidence from Chinese listed companies (2011-2022), revealing a significant negative correlation between fintech advancement and corporate carbon emissions. Their analysis demonstrates that fintech effectively reduces emissions through two primary mechanisms: alleviating financial constraints and fostering green innovation. This finding is particularly significant as it represents one of the first comprehensive firm-level investigations of the fintech-carbon emissions nexus.

Building on this firm-level analysis, Cheng et al. (2023) extend the examination to urban-level impacts, analyzing 253 prefecture-level cities in China from 2011 to 2019. Their research confirms that fintech development can significantly reduce urban carbon emissions, with the

breadth of coverage and level of digitalization within fintech having particularly pronounced negative impacts on emissions. The study identifies three key mechanisms through which fintech achieves emission reductions: industrial structure upgrading, financing constraint alleviation, and green technology innovation (GTI). These findings remain robust across various endogeneity tests and alternative measurements, providing strong empirical support for fintech's environmental benefits.

The geographical scope of fintech's carbon reduction impact extends beyond China, as demonstrated by Kashif et al. (2024), who examined 58 advanced countries from 2010 to 2022. Their study reveals that climate finance, facilitated by fintech innovations, improves long-term ecological sustainability by significantly lowering ecological footprints. The research employs sophisticated econometric approaches, including two-step System Generalized Method of Moments (Sys GMM), and demonstrates that fintech has a strong positive effect on ecological performance by decreasing environmental footprints.

Zhang et al. (2024) contribute to the literature by examining fintech's impact on carbon emission efficiency (CEE) rather than absolute emissions, utilizing Chinese city panel data from 2007 to 2019. Their research reveals that fintech significantly improves CEE through two primary transmission channels: green technological innovation and green finance. Importantly, their dynamic spatial Durbin model analysis uncovers significant positive spatial spillover effects, indicating that fintech's environmental benefits extend beyond immediate geographical boundaries. The study finds that long-term spillover effects are smaller than short-term effects, suggesting the importance of sustained fintech development policies. The spatial dimension of fintech's environmental impact is further supported by heterogeneity analysis, which reveals that fintech's improvement effect on CEE is primarily evident in eastern regions, emerging first-tier and first-tier cities, and non-resource-based cities (Zhang et al., 2024). This finding has important policy implications for targeted fintech development strategies and suggests that regional characteristics moderate fintech's environmental effectiveness.

The integration of fintech with green finance emerges as a crucial factor in enhancing carbon emission reduction effectiveness. Cheng et al. (2024) investigate how fintech development influences the carbon emission reduction effects of green finance using a two-way fixed effects model with panel data from 30 Chinese provinces (2011-2020). Their findings indicate that the negative impact of green finance on carbon emissions is significantly heightened in areas with high levels of fintech development, suggesting a synergistic relationship between these two financial innovations. Regional disparities in this relationship are noteworthy, with fintech having statistically significant impacts on green finance effectiveness in central and western regions, while its significance is absent in eastern regions. The mechanism analysis reveals that fintech enhances green finance's capacity to mitigate carbon emissions through three primary channels: promoting green technology innovation, alleviating corporate financing constraints, and optimizing energy structure.

The literature extends beyond carbon emissions to examine fintech's broader environmental implications. Vu et al. (2024) analyze 42 countries from 2012 to 2021, employing machine learning techniques to construct comprehensive fintech development indices. Their research demonstrates that fintech development improves environmental quality by encouraging low-carbon energy consumption and mitigating anthropogenic polluting emissions. However, they identify an important moderating factor: high-income inequality counteracts the favorable effects of fintech development on the environment, highlighting the importance of addressing socioeconomic disparities alongside technological advancement.

Mertzanis (2023b) provides additional cross-country evidence using novel data from the Bank of International Settlements, examining 58 countries from 2013 to 2019. The study reveals a modest but statistically significant positive effect of fintech market growth on environmental performance, measured through the environmental performance index (EPI). Moreover, the research demonstrates that government effectiveness plays a prominent role, exerting both direct positive impacts on environmental performance and indirect effects through its influence on fintech market growth.

The literature increasingly recognizes fintech's role in advancing broader sustainable development objectives beyond carbon emission reduction. Raman et al. (2025) employ a mixed-methods approach to investigate sustainable and green finance's role in advancing UN Sustainable Development Goals, with particular emphasis on SDG 13 (climate action). Their cocitation analysis reveals the central role of SDG 13 and its interconnectedness with SDGs related to economic growth (SDG 8), industry and infrastructure (SDG 9), clean energy (SDG 7), and environmental sustainability (SDGs 6, 15). The study identifies innovations such as green fintech, social impact bonds, and risk models as crucial for facilitating renewable investment and mitigating environmental impacts. However, barriers including high transaction costs and insufficient institutional frameworks in developing countries continue to hinder broader adoption of green finance tools, suggesting the need for targeted policy interventions.

Jangid et al. (2025) contribute to understanding fintech's role in the broader energy-growth-environment nexus, analyzing G-20 economies from 2005-2022 using panel vector autoregressive (PVAR) models. Their findings confirm that fintech has a positive impact on the energy-growth-environment nexus, with technological innovation showing similar favorable influences. The research reveals that while energy has positive influences on growth and environment, rising carbon emissions exert negative influences on growth and renewable energy consumption, underscoring the importance of fintech-enabled solutions for sustainable development.

The literature also addresses fintech's role in climate resilience and risk management. Mhlanga (2022) examines financial technology's role in addressing climate change challenges in the Fourth Industrial Revolution context, demonstrating that financial inclusion through fintech can aid in building resilience for households, individuals, and companies facing rapid climate events or gradual climate change effects. The study emphasizes that insurance, savings, credit, money transfers, and new digital distribution channels can help climate change victims and environmental managers adapt to new realities.

Toumi et al. (2023) provide insights into the market performance implications of environmental initiatives in fintech companies, analyzing 48 fintech and 140 non-fintech firms during the pandemic (2011-2022). Their research reveals that fintech firms demonstrated better environmental performance (78.4%) compared to non-fintech firms during the pandemic, with environmental disclosures contributing almost 10.2% to fintech firms' market performance. This finding suggests that environmental considerations are increasingly valued by stakeholders in the fintech sector.

The existing literature provides robust evidence that climate fintech companies play a crucial role in reducing carbon emissions and facilitating the transition toward sustainable, low-carbon economies. The mechanisms through which fintech achieves these outcomes include alleviating financing constraints, promoting green technology innovation, optimizing energy structures, and enhancing the effectiveness of green finance initiatives. However, the literature also highlights the importance of institutional quality, government effectiveness, and addressing socioeconomic disparities to maximize fintech's environmental benefits.

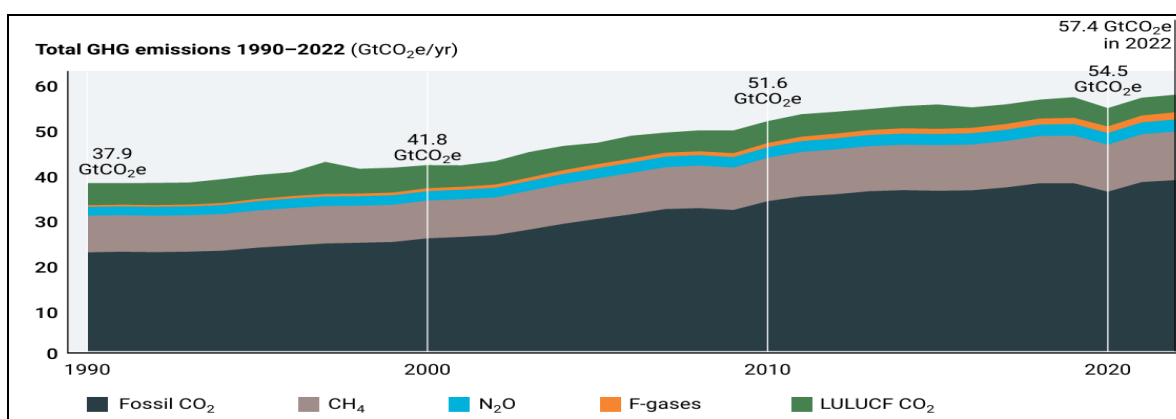
While these studies have established the foundational understanding of fintech's environmental impact through various analytical lenses, there remains a critical gap in specifically examining climate fintech companies as distinct entities within the broader fintech ecosystem. The current literature predominantly treats fintech as a homogeneous sector or focuses on general fintech applications, without isolating the unique characteristics and mechanisms of companies specifically designed for climate action. This gap presents a significant opportunity for the present study to extend the existing knowledge base by focusing specifically on climate fintech companies and their targeted contributions to SDG 13 achievement. While previous research has demonstrated that fintech broadly supports environmental objectives, this study seeks to understand how specialized climate fintech companies—with their dedicated focus on climate solutions, carbon reduction technologies, and sustainable finance products—may exhibit different patterns, mechanisms, and effectiveness in carbon emission reduction compared to general fintech applications.

Furthermore, the literature's emphasis on geographical heterogeneity (Cheng et al., 2024; Zhang, 2024) and the need for context-specific analysis suggests that examining climate fintech companies' role in achieving globally standardized targets like SDG 13 could provide valuable insights for international climate policy coordination. By building upon the established theoretical frameworks and empirical methodologies demonstrated in the reviewed studies, this research aims to contribute a more nuanced understanding of how purpose-built climate fintech solutions can accelerate the transition toward sustainable and low-carbon economies, thereby extending the literature's scope from general fintech environmental impacts to specialized climate-focused financial technologies.

### III. Carbon Emissions – Causes and Evolution

Carbon emissions refer to the release of carbon dioxide (CO<sub>2</sub>) and other greenhouse gases into the atmosphere as a result of various human activities. These emissions are typically measured in terms of carbon dioxide equivalent (CO<sub>2</sub>e), which standardizes the impact of different greenhouse gases based on their global warming potential (Friedlingstein et al., 2020; Ridhosari & Rahman, 2020). To contextualize the urgency of addressing these emissions within the framework of sustainable development and climate action, the growth in carbon emissions can be illustrated through Figure 1, which covers the period from 1990 to 2022 and shows the development of major emissions worldwide.

**Figure 1. Total Net Human Greenhouse Gas Emissions (1990–2022)**



Source: United Nations Environment Programme (2023, p. XVII)

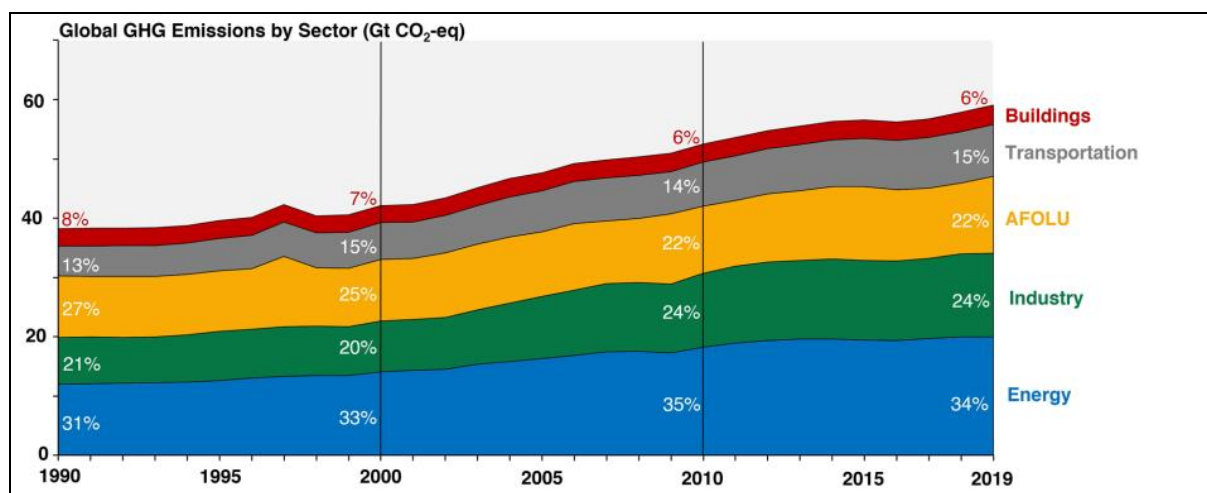
Figure 1 demonstrates a pronounced and persistent upward trajectory in global greenhouse gas emissions throughout the period 1990-2022, culminating in unprecedented levels of 54.4 gigatons of carbon dioxide equivalent in 2020 and escalating further to 57.4 gigatons by 2022. This sustained growth pattern underscores the intensification of anthropogenic climate forcing despite international mitigation efforts and policy interventions. The predominant drivers of this aggregate increase are attributable to carbon dioxide emissions originating from fossil fuel combustion and industrial processes, which collectively constitute approximately two-thirds of contemporary greenhouse gas emissions. Concurrently, emissions of methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and fluorinated gases (F-gases) exhibit accelerated growth rates, representing a particularly concerning trend given their substantial global warming potential and their collective contribution of approximately one-quarter to current greenhouse gas emissions. This multifaceted emissions profile highlights the complexity of the climate challenge and reinforces the critical need for comprehensive decarbonization strategies that address both carbon dioxide and non-carbon dioxide greenhouse gases across all economic sectors.

Given this alarming trajectory of escalating greenhouse gas emissions, it becomes imperative to examine the underlying drivers that have perpetuated this unsustainable growth pattern. The complexity and persistence of emission increases across multiple greenhouse gas categories suggest that the phenomenon is rooted in systemic factors that transcend individual sectors or geographical boundaries. These fundamental causes include: (United Nations, 2025)

- *Generating Power:* The electricity and heat generation sector constitutes a major source of global greenhouse gas emissions through the continued reliance on fossil fuel combustion. Coal, oil, and natural gas remain the dominant energy sources for power generation, releasing substantial quantities of carbon dioxide and nitrous oxide into the atmosphere;
- *Manufacturing Goods:* Industrial manufacturing processes contribute significantly to greenhouse gas emissions through energy-intensive production methods and chemical processes. The production of cement, iron, steel, electronics, plastics, and textiles requires substantial energy inputs, predominantly from fossil fuel sources;
- *Cutting Down Forests:* Deforestation represents a critical driver of carbon emissions by releasing stored carbon while simultaneously reducing natural carbon sequestration capacity;
- *Using Transportation:* The transportation sector contributes substantially to global emissions through widespread dependence on fossil fuel-powered vehicles across all transport modes. Road vehicles, primarily operating on petroleum-based fuels, constitute the largest source of transport emissions, while maritime and aviation sectors show concerning growth trends;
- *Producing Food:* Agricultural systems generate greenhouse gas emissions through multiple pathways including land-use conversion, livestock methane production, and energy-intensive farming practices. Ruminant livestock digestion, synthetic fertilizer production and application, and mechanized equipment operation contribute significant quantities of methane, nitrous oxide, and carbon dioxide;
- *Powering Buildings:* The built environment consumes over half of global electricity through residential and commercial operations, generating substantial emissions through continued fossil fuel dependence for heating, cooling, and power;
- *Consuming Too Much:* Household consumption patterns drive significant greenhouse gas emissions through direct energy use and embedded emissions in goods and services. Individual carbon footprints encompass residential energy, transportation, diet, waste generation, and consumer goods including electronics, textiles, and plastics.

These diverse emission sources can be systematically categorized according to their respective economic sectors, providing a comprehensive framework for understanding the structural origins of greenhouse gas emissions. Figure 2 illustrates the disaggregation of global greenhouse gas emissions by economic sector.

**Figure 1. Global Greenhouse Gas Emission by Economic Sector (1990-2019)**

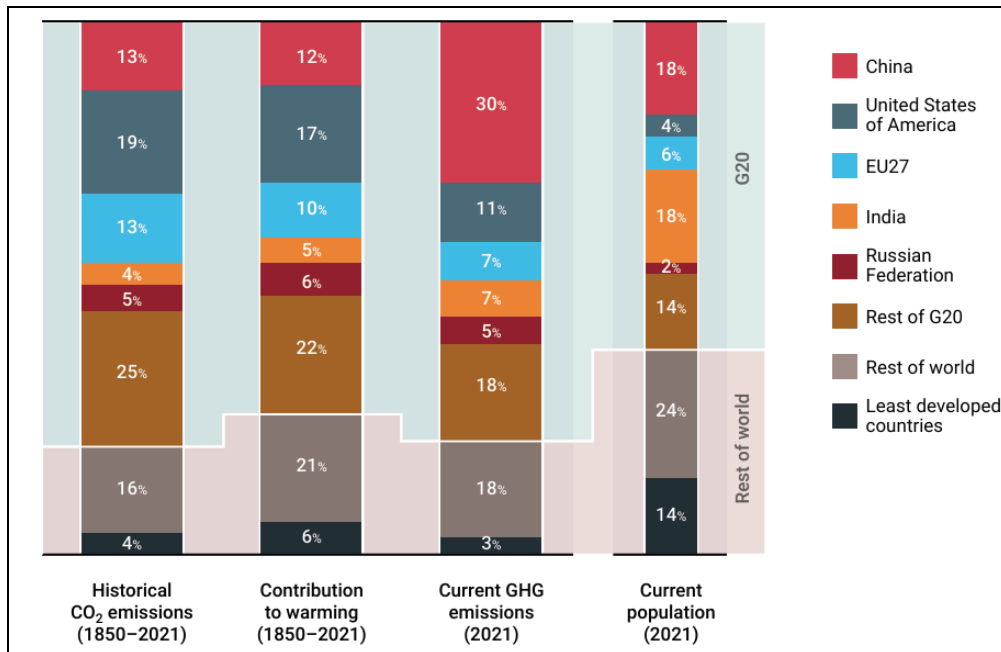


**Source: Environmental Protection Agency (2025)**

Figure 2 provides a longitudinal analysis of global GHG emissions disaggregated by five major sectors: Energy, Industry, AFOLU (Agriculture, Forestry, and Other Land Use), Transportation, and Buildings. It reveals the absolute growth in emissions over time—rising from just over 40 Gt CO<sub>2</sub>-eq in 1990 to more than 60 Gt CO<sub>2</sub>-eq in 2019—and other structural trends within the global economy. The energy sector, represented in blue, consistently dominates the emissions profile, accounting for 31% in 1990 and increasing to 34% by 2019, highlighting the persistent global reliance on fossil fuels for electricity and heat production. Industry (green) remains the second largest contributor, growing from 21% to 24%, reflecting the expanding industrial output and globalization of production. Meanwhile, AFOLU (orange) showed a slight decline in its share—from 27% in 1990 to 22% in 2019—likely due to improved land management and reduced deforestation in some regions, though it remains a critical sector for emissions and potential mitigation. The transportation sector (grey) maintains a stable yet significant share, fluctuating around 13–15%, underscoring the continued challenges in decarbonizing mobility and freight systems. Lastly, buildings (red) consistently contribute 6–8%, reflecting both direct emissions from heating and cooling as well as indirect energy use. Despite its smaller share, this sector's emissions are particularly important for urban planning and energy efficiency strategies.

It is worth noting that there is a disparity among countries in their contributions to these emissions. The primary reason for this discrepancy lies in differences in levels of development and innovation. This is illustrated in Figure 3.

**Figure 03: Countries' Current and Historic Contribution to Carbon Emissions**



**Source: United Nations Environment Programme (2023, p. XVIII)**

Figure 3 reveals the stark disparity in emission contributions among different economic groups, showing a strong positive correlation between the level of economic development and the volume of carbon emissions. The least developed countries record the lowest emission levels, reflecting limited industrial activity and energy consumption, while major industrial powers dominate the global emissions landscape. China tops the ranking, contributing 30% of total greenhouse gases and 18% of global warming, driven by two key structural factors: first, demographic pressure, which imposes immense energy demands and necessitates large-scale infrastructure development; and second, a rapid development model aimed at achieving global economic competitiveness. It is followed by the United States, the European Union countries, and India—highlighting the geographical concentration of emissions in major industrial economies and raising fundamental questions about climate justice and historical responsibility in addressing climate change.

#### **IV. Climate Fintech –Concept and Relationship to Carbon Emission Reduction**

Amid growing concerns over the consequences of carbon emissions, major countries around the world have sought to develop substantial solutions to mitigate this issue. There is a general consensus that financial technology (fintech) may represent the most effective solution, given its advanced and transformative capabilities.

Climate FinTech is the convergence of financial technology and climate action, employing innovative digital tools and platforms to accelerate and scale solutions addressing climate change. It involves strategic realignment of financial systems to prioritize environmental sustainability by directing capital toward green initiatives, mitigating climate-related financial risks, and ensuring transparency and accountability in environmental impact reporting. It leverages technologies such as blockchain, AI, and data analytics to enhance investing in renewables, carbon credit trading, and sustainable projects. Climate FinTech represents a transformative socio-technical system reshaping

financial paradigms to respond to anthropogenic climate change and advancing Sustainable Development Goal 13 (Sustainability Directory, 2025).

The International Monetary Fund Staff Climate Notes (Loukoianova, Natalucci, Wang, et al., 2024) define FinTech to the use of digital technology that catalyzes climate change mitigation and adaptation through financial services. It facilitates making environmentally friendly financial decisions by individuals and businesses and helps scale up climate finance by enhancing data and information flows, making climate-related projects more attractive to investors. The ecosystem includes green digital banking, sustainable investing and asset management, carbon markets and offset platforms, climate risk analytics, insurance technologies, green crowdfunding and lending, and regulatory technology for climate compliance.

Academically, Climate FinTech is understood as a complex socio-technical system undergoing rapid evolution that challenges traditional financial models by embedding ecological and climate considerations within financial instruments and investment strategies. It requires interdisciplinary approaches, merging environmental economics, computer science, behavioral finance, and political ecology to analyze its impact on climate action and green finance integration effectively (Sustainability Directory, 2025). Moreover, from General industry definition, Climate FinTech companies operate at the intersection of climate, finance, and technology. They develop financial technology solutions aimed specifically at mitigating climate change and promoting sustainability, sometimes referred to as green fintech (Andrias, 2023).

In light of these developments, and with the United Nations' efforts to make it more supportive of the ecosystem, the fintech technologies have diversified. According to numerous studies, climate fintech technologies can be categorized into eight main types: (Muganyi et al., 2021)

- *Green Digital Accounts and Payment Solutions:* These refer to digital payment platforms that directly incorporate environmental considerations into their services. Examples include offering advice on the environmental impact of purchases, providing rewards for eco-friendly purchasing behavior, and more. Notable platforms in this category include PayGreen, Doconomy, and Tomorrow;
- *Green Digital Investment Solutions:* These are digital advisory platforms that provide guidance on green investments, manage green investment portfolios, and offer risk assessments based on environmental standards. Prominent examples include Inyova, FNZ, Cushon, and Ethic;
- *Digital ESG Data and Analysis Solutions:* These digital platforms supply comprehensive environmental, social, and governance (ESG) information for investors, including green asset classification, green finance analysis, automated ESG scoring of companies, and automated environmental risk monitoring. Key platforms include Miotech and Novisto;
- *Green Crowdfunding Platforms:* These platforms finance green business and industrial projects, assets, and initiatives, including green donations, by collecting small contributions from a large number of individuals. Examples include Ulule, Bettervest, and Trine;
- *Green Digital Risk Analysis and Insurance Technology:* These are digital technologies and platforms that use artificial intelligence and satellite imagery to improve various insurance services, offer solutions to reduce climate and natural disasters, and implement smart contracts in digital insurance—particularly useful for compensating environmental risks. Examples include Arbol, Jupiter, and Cervest;
- *Green Digital Lending and Deposit Solutions:* These platforms offer digital loans to fund environmentally friendly projects and provide green mortgages. They also track the green behaviors of beneficiaries. Leading platforms include Hemma and Tandem;

- **Green Digital Assets:** These technologies focus on building green capital market infrastructure using blockchain and cryptocurrencies, including the issuance of green assets through tokenization. Well-known platforms in this space include MOSS and Toucan;
- **Green Compliance Platforms:** These platforms establish regulatory compliance frameworks for green financial operations and related projects. They assign green ratings to corporate practices, monitor environmental compliance in companies and financial institutions, and provide additional services such as anti-money laundering measures, risk reporting, green product and service evaluations, and sustainability classifications. Examples include Datia and Greenomy.

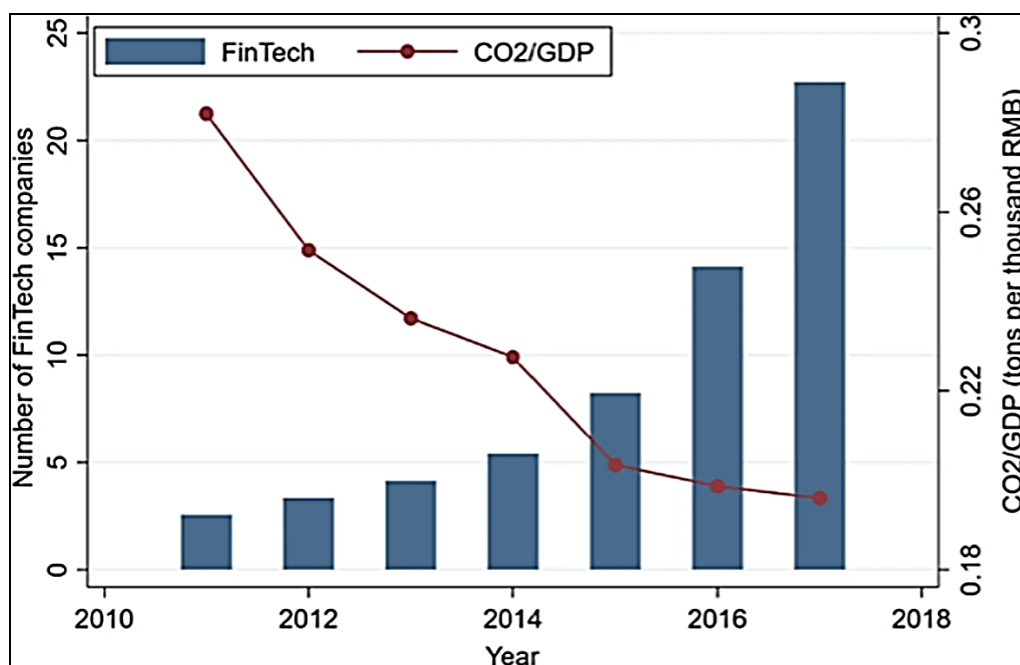
## V. The Importance of Climate FinTech in Climate Protection and Emission Reduction

The focus on financial technology has not been limited to reducing costs and offering a range of innovative services; it has also taken on a more significant dimension—namely, the promotion of environmental sustainability. According to numerous studies, fintech contributes effectively to strengthening various environmental aspects, which can be summarized through the following key points:

### V.1. Reducing Carbon Emissions

Many fintech companies are working to integrate green financial system measures aimed at reducing carbon emissions and facilitating the optimal use of resources (Muganyi et al., 2021). According to the theoretical analysis of this study and a review of several previous studies and reports, there remains a lack of statistics that directly link the contribution of climate fintech companies to actual emission volumes. This gap led to the use of a Chinese empirical study conducted for the period 2010–2018 (Wu, 2024) to assess the impact. Figure 4 illustrates the results of that study.

**Figure 04: The Role of FinTech in Reducing Carbon Emissions**



Source: Wu (2024)

Figure 4 provides compelling empirical evidence of the inverse relationship between fintech development and carbon intensity, demonstrating a clear temporal pattern that supports the

theoretical framework established in the literature. The data reveals a consistent upward trajectory in the number of fintech companies from 2010 to 2018, with particularly accelerated growth observed after 2014, culminating in approximately 23 companies by 2018. Concurrently, the CO<sub>2</sub>/GDP ratio exhibits a pronounced downward trend, declining from approximately 0.29 tons per thousand RMB in 2011 to 0.19 tons per thousand RMB in 2018, representing a substantial 34% reduction in carbon intensity over the study period.

The temporal dynamics illustrated in this figure are particularly noteworthy, as the steepest decline in carbon intensity occurs during 2011-2015, coinciding with the initial phase of fintech expansion. This pattern suggests that even modest increases in fintech presence can generate significant environmental dividends, supporting the hypothesis that fintech companies facilitate decoupling economic growth from carbon emissions. The stabilization of the CO<sub>2</sub>/GDP ratio after 2016, despite continued fintech growth, may indicate either diminishing marginal returns or the presence of other confounding factors that warrant further investigation.

## **V.2. Positive Impact on the Ecological Environment**

This is achieved by promoting economic development and improving economic efficiency (Yang et al., 2021).

## **V.3. Enhancing the Efficiency of Green Financing**

FinTech's reliance on artificial intelligence, big data, and smart credit analysis enables more efficient management of green credit, which ensures better outcomes in this area (Zhou et al., 2022).

## **V.4. Improving Environmental Efficiency**

The use of climate FinTech allows for effective management of natural resources and the provision of innovative and environmentally friendly products and services. This contributes to an increase in clean waste and a reduction in harmful waste, thereby enhancing environmental efficiency (Xu et al., 2023).

## **V.5. Strengthening Green Finance Sources**

FinTech offers various alternatives in the field of green finance, such as crowdfunding platforms, green equity offerings, and other sources that support environmental protection by focusing on the key enabler—funding (Qin et al., 2024). It also provides multiple sources of financing in a short time and at a lower cost than traditional alternatives (Deng et al., 2019).

## **V.6. Enhancing Climate Security**

Climate FinTech strengthens climate security by tracking emissions and imposing penalties on contributing companies. Many companies also incentivize environmentally friendly practices by offering financial rewards for positive actions (Loukoianova, Natalucci, Kanada, et al., 2024).

## **V.7. Energy Conservation**

According to several studies, the cost reduction in FinTech services and faster accessibility helps lower energy consumption, especially amid growing research into the use of clean energy in the development of financial technologies (Mertzanis, 2023a).

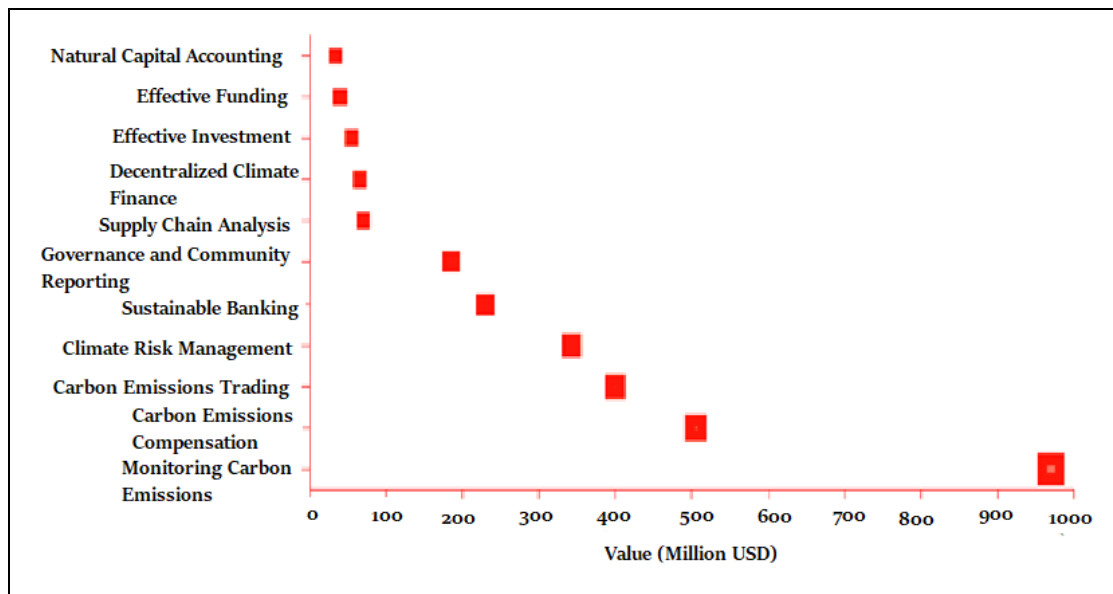
## **V.8. Direct Impact of FinTech on Carbon Emissions**

FinTech facilitates the digital transformation of financial institutions, helping shift offline economic activities to online platforms, thereby reducing carbon emissions. By moving financial operations to digital platforms, unnecessary economic activities are minimized (Cheng et al., 2023).

### V.9. Climate Risk Management

Climate FinTech companies use satellites and smart devices to track and reduce carbon emissions and raise awareness about environmental issues. They also focus on environmental protection and climate preservation by promoting green financing. This is illustrated in figure 5.

**Figure 05: Environmental and Climate Funding for FinTech Companies in 2022**

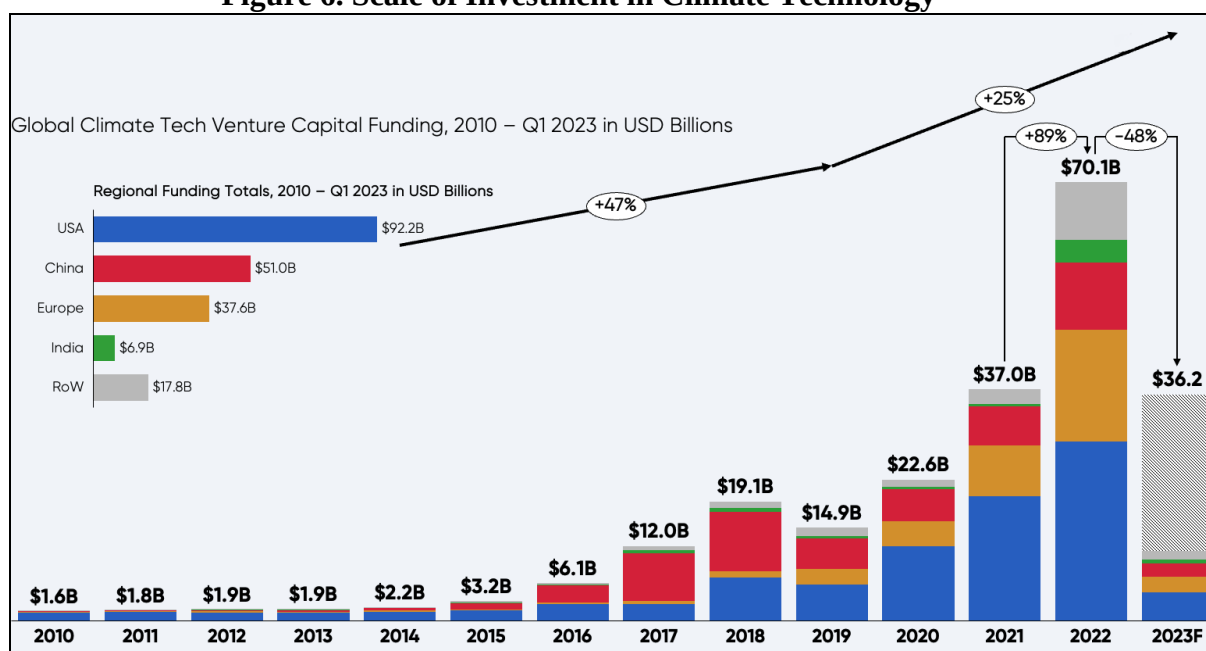


Source: CNN Business (2023)

Figure 5 shows the total climate tech funding by sector during the year 2022, which amounted to approximately \$2.9 billion. The sector that benefited the most was the carbon emissions sector, receiving around 1 billion Dollars, in line with the pursuit of the Net Zero Emissions strategy by 2050. It is followed by the emissions offset sector, which received over 500 million Dollars, highlighting the significant global focus on addressing emissions issues, especially amid anticipated risks.

This technology allows for a type of harmonization and alignment with the demands of the 21st century—particularly over the past decade, during which climate concerns have become a central focus for major world powers. Figure 6 illustrates the scale of investment in climate technology.

**Figure 6. Scale of Investment in Climate Technology**



Source: HolonIQ (2023)

Figure 6 highlights the growing interest in climate technology investment financing, as it has become one of the most urgent priorities of our time—especially after 2018. Despite international agreements made in 2015 to address carbon emissions and ways to reduce them, the year 2020 witnessed a significant surge in this field, particularly in the United States, due to the environmental and even economic impacts of carbon emissions. As shown in the figure, interest in this sector grew even more after the COVID-19 pandemic, with global investments in climate tech reaching \$70.1 billion in 2022, and around \$36.2 billion in the first quarter of 2024. According to the figure, the United States leads in terms of investment volume in this area, followed by China.

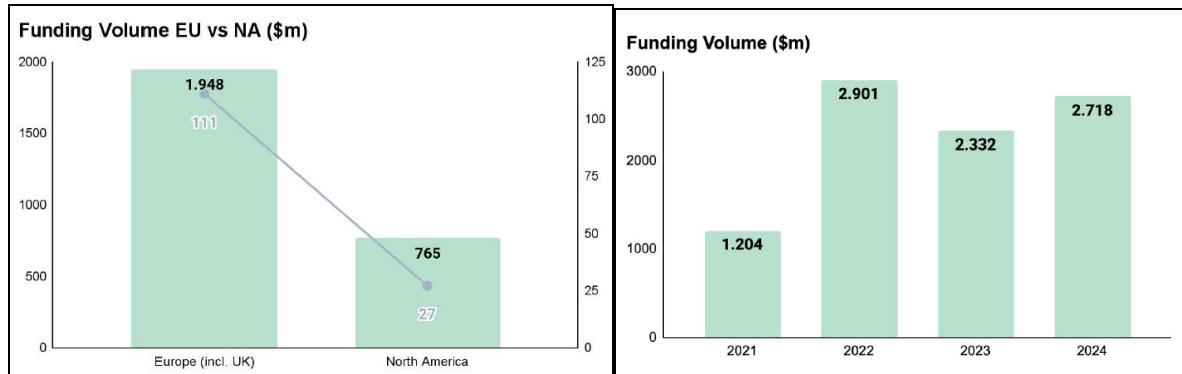
Moreover, investment in climate financial technology offers several advantages, including (Loukoianova, Natalucci, Kanada, et al., 2024):

- Reducing transaction costs and improving capital efficiency;
- Lowering environmental protection costs and enhancing competitiveness;
- Reducing information asymmetry and improving risk management by integrating big data management with green project data, thereby accelerating decision-making processes regarding financing decisions by banks;
- Ensuring the authenticity of green assets: Fintech uses blockchain technology to digitize green assets, thereby mitigating information asymmetry.

## VI. The Size of the Climate Fintech Market and Its Challenges

The scale of financial commitment to climate fintech ventures can be observed through funding patterns over recent years, as illustrated in the Figure 6 depicting funding volumes for

**Figure 7. Volume of Funding for Climate Fintech Startups (2021–2023)**



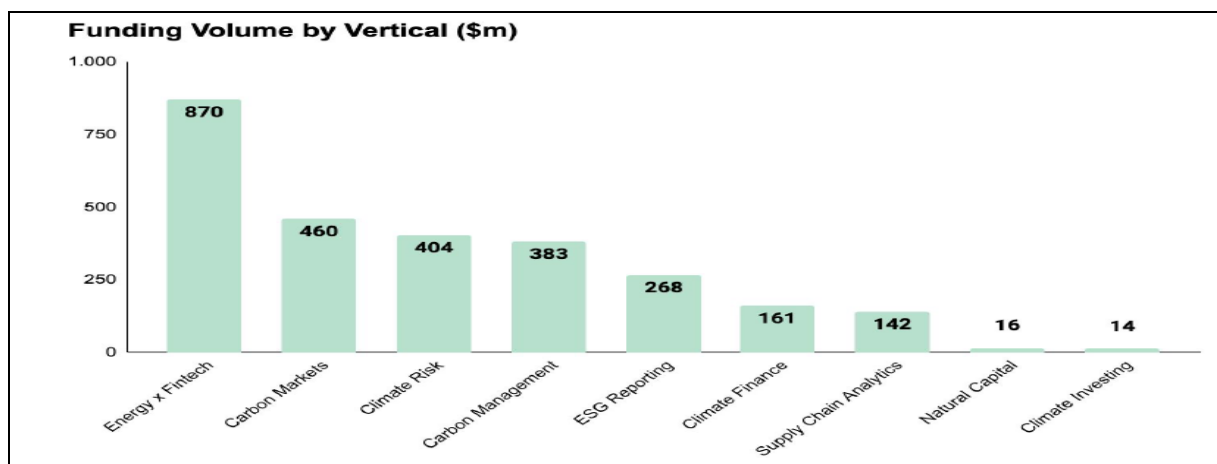
Source: Commerz Ventures (2025, pp. 7-8)

Figure 7 reveals the dynamic development of the funding market in the climate fintech sector, which witnessed rapid growth, peaking at \$2.901 billion. However, this growth faced a notable challenge in 2023, with a 19% decline—reflecting a broader downturn in the fintech ecosystem overall. This decline is attributed to several structural factors, most notably the failure of many startups to achieve sustainable business models, in addition to tighter credit conditions and investors' reassessment of the risks associated with emerging technologies.

Geographically, Europe stands out as a global leader in climate fintech funding, securing \$1.361 billion in 2023—approximately 1.5 times the amount of comparable investments in the United States. This European dominance can be explained by the EU's advanced regulatory framework for sustainable finance, the continent's ambitious commitment to carbon neutrality, and a supportive investment environment for green financial innovation. This geographic distribution of investments highlights the differences in political priorities and climate strategies across regions and underscores the critical role of government policies in directing capital flows toward climate tech solutions.

Moreover, amid growing interest in climate issues and the negative impacts of carbon emissions and pollution, and based on the eight major sectors of this type of financial technology, the funding for these companies in 2023 was distributed as shown in Figure 8.

**Figure 8. Volume of Climate Tech Company Funding by Type in 2023**



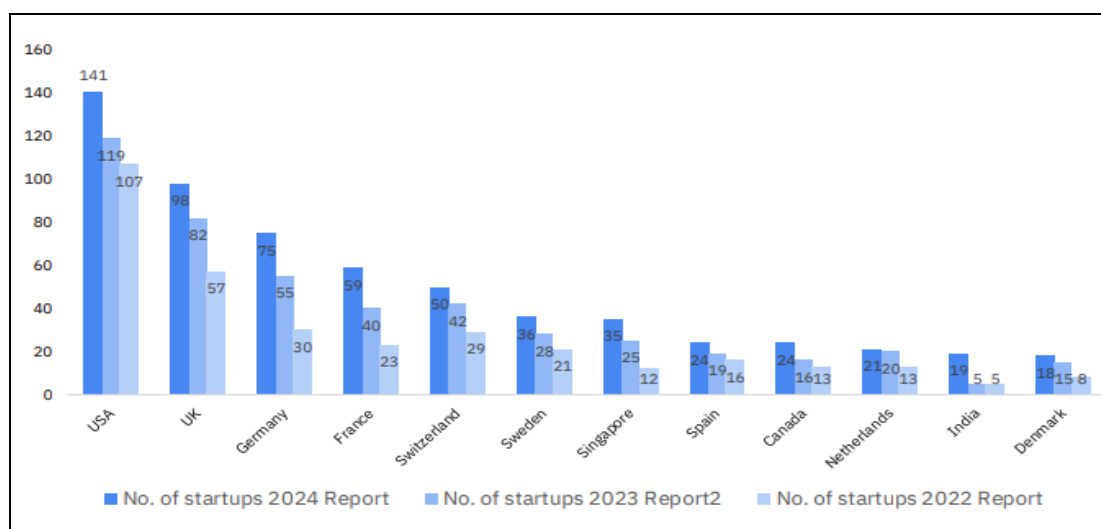
Source: Commerz Ventures (2025, p. 10)

Figure 8 reveals the sectoral distribution of investments in climate fintech startups, with the carbon market leading the investment landscape, receiving \$729 million in funding. This highlights the strategic priority of carbon pricing and trading mechanisms as central tools in combating climate change. The energy sector ranks second with \$530 million in funding, followed by other sectors with varying amounts, reflecting the diversification of climate fintech solutions.

This investment concentration in carbon markets demonstrates the growing recognition of carbon emissions as one of the most pressing environmental threats. Carbon emissions are no longer seen merely as traditional pollutants, but as a major driver of radical climate shifts—such as the global temperature rising by 1.5°C above pre-industrial levels. Climate models warn that a 3°C increase could trigger catastrophic climate collapse, including the disruption of seasonal weather patterns and intensification of extreme climate events. The dominance of carbon market investments reflects a deep understanding of the "true cost of carbon," whereby these markets aim to translate environmental and climate costs into tangible economic values. This creates strong financial incentives to reduce emissions and steer investments toward low-carbon technologies. Such investment trends underscore the critical role of innovative financial mechanisms in achieving the sustainable development goals related to climate action.

While the sectoral distribution of investments reveals strategic priorities in addressing climate challenges, the geographical allocation of climate fintech funding provides equally important insights into regional leadership and competitive dynamics in this emerging market. The concentration of capital across different countries reflects varying levels of policy support, regulatory frameworks, and market maturity for climate-focused financial innovations. Understanding this geographical distribution is crucial for assessing global capacity for climate action and identifying potential collaboration opportunities between regions. Figure 09 illustrates the distribution of climate fintech startup funding by country in 2023, revealing the international landscape of investment flows in this critical sector.

**Figure 9. Distribution of Climate Fintech Startup Funding by Country in 2023**



**Source: Tenity (2024)**

Figure 9 reveals a pattern of rapid and consistent growth in the number of climate fintech startups across the various countries under study, reflecting the growing global interest in technological solutions to climate challenges. The United States leads this landscape with the highest number of such startups, reaching 141 in 2023, followed by the United Kingdom with 98,

while Denmark records the lowest figure with 18 startups in the same year. This disparity in geographical distribution reflects multiple structural factors that explain the dominance of developed countries in this emerging sector. Firstly, these countries face moral pressure and historical responsibility as the largest contributors to the accumulation of global carbon emissions, driving them to invest in compensatory solutions and innovative technologies to address their environmental impact. Secondly, they benefit from advanced tech ecosystems that include fintech giants and leading companies in financial innovation, providing the technical infrastructure and expertise needed to develop climate fintech solutions. This convergence of climate responsibility and advanced technological capability creates an ideal environment for the growth of this sector in developed economies.

However, despite these advantages and the sector's promising trajectory, climate fintech faces significant obstacles that must be addressed for its continued development and global expansion. The challenges of climate fintech are essentially as follows: (Augé, 2025; Vivekananda Institute of Professional Studies-TC, 2024)

- *Lack of unified green standards:* There are numerous operational standards in the field of green finance that remain unresolved or have yet to be developed. These include standards for environmental data, methodologies for calculating environmental benefits, specifications for green financial products, and guidelines for identifying green projects;
- *Environmental information transparency:* Environmental data serves as the cornerstone for conducting environmental risk analysis. The accuracy and reliability of this data play a crucial role in determining the precision and effectiveness of environmental risk assessments. For example, inaccuracies in pollutant emission data can lead to discrepancies between corporate public disclosures and the actual environmental impact of a company's pollution;
- *Low levels of professional capacity in green finance and fintech:* Successfully integrating fintech into green finance requires skilled utilization of big data, alongside robust data governance mechanisms and expertise in both fintech and environmental science. For instance, assessing green products and projects is often outsourced by financial institutions to third-party environmental service providers. However, these providers may lack familiarity with the complexities of the financial sector and tend to operate with less technologically advanced approaches, resulting in higher costs and slower processes;
- *Inability to price climate risks:* Climate change is no longer a distant reality; its effects are already being felt, leading to extreme weather events and significant financial losses. This presents a challenging era for financial institutions, especially when such individual events become recurring patterns. Investment managers face the daunting task of integrating climate change projections into risk assessments and return expectations that guide security selection in investment portfolios. However, the lack of high-quality and comprehensive datasets undermines their ability to do this effectively.

## **VII. Conclusion:**

This study addressed one of the core issues related to the global transition toward sustainable development—namely, highlighting the pivotal role that climate fintech companies play in reducing carbon emissions. Carbon emissions remain the greatest environmental challenge of our time due to their severe consequences, including climate change, increased environmental disasters, and rising global environmental and economic risks. The rapid technological transformations ushered in by the Fourth Financial Revolution have shown that fintech tools represent a strategic

opportunity to reshape mechanisms for financing environmental projects, tracking emissions, and offering innovative and sustainable solutions.

The study demonstrated that these companies go beyond providing traditional financial services. They are increasingly recognized as environmental actors through innovations classified into eight main categories, ranging from artificial intelligence and big data analytics to blockchain technologies and platforms for financing green projects.

The study reached several key findings, among the most prominent:

- Carbon emissions have continued to increase annually, posing a threat to environmental stability and negatively affecting human health and global economic systems;
- The bulk of carbon emissions originate from developed countries—chiefly China, the United States, and certain European nations—placing a historical responsibility on them to lead mitigation efforts;
- The energy and electricity generation sectors remain the primary sources of these emissions, calling for a structural transition toward clean energy sources;
- The past three years have witnessed a significant surge in global investments directed toward climate fintech, reflecting growing awareness of the severity of the climate crisis and the need to address it using smart, effective tools;
- Climate fintech technologies are diverse, extending beyond green finance to include advanced solutions for emissions tracking, smart agriculture, and environmental data analytics;
- The United States and other advanced economies continue to lead in developing these technologies, positioning them at the forefront of shaping the global climate agenda;
- Climate fintech companies offer multiple benefits for protecting the planet, including mobilizing financial resources, directing investments toward sustainable projects, and helping build low-carbon economic models;
- These companies play a strategic role in achieving climate security, which is now seen as an integral component of national, economic, and social security;
- However, they face structural challenges, most notably the lack of unified environmental standards, insufficient transparency in climate data, a shortage of specialized talent at the intersection of technology and the environment, and the difficulty of accurately pricing climate-related risks.

Based on the findings above, the following recommendations are proposed to support and develop climate fintech within the framework of achieving sustainable development goals:

- Establish a unified international framework to regulate carbon emissions reduction efforts, grounded in transparency and climate justice;
- Promote climate awareness among individuals and encourage community participation in building a greener, more sustainable planet;
- Increase political and financial support for startups in the environmental technology sector, particularly in developing countries;
- Activate oversight mechanisms for climate fintech companies to ensure their genuine commitment to sound environmental practices;
- Expand global climate fintech initiatives through the creation of international partnerships that foster knowledge and expertise exchange;

- Invest in clean energy sources to power fintech technologies, with a focus on improving energy efficiency in digital infrastructure.

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