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Review

# Environmental finance under ESG: A literature review and synthesis

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**Abstract:** This paper aims to review the literature on ESG (environment, social, and governance) finance based on the Scopus database and synthesize the review. Three advantages of embracing ESG in corporate finance are identified based on the literature reviewed. First, this positively influences financial investment decisions; second, it can leverage advancements in technology and innovations; and third, it can create proactive risk management. Overall, it is still believed and conceptually accepted that integrating ESG criteria within the investment decision-making process brings a consolidated approach to the investment strategy, aligning social and environmental benefits with financial returns and driving positive performance and shareholder value in the long run.

**Keywords:** finance; ESG; environment; business

## 1. Introduction

Environment, social, and governance (ESG) factors have emerged as crucial considerations in the financial sector's decision-making process. Literature on 'ESG finance' can be widely found [1–53]. ESG encompasses many issues impacting companies' long-term sustainability and profitability [54]. Sustainability rating agencies provide comprehensive ESG ratings and evaluations that assist investors in assessing the ESG performance of companies [55]. By incorporating ESG scores and ratings into their analysis, investors can make more informed decisions and allocate capital to companies prioritising environmental responsibility, social impact, and strong corporate governance. ESG finance has become a significant megatrend, driving major changes in how businesses approach sustainability and long-term value creation. This trend has influenced the strategic decisions of top management and has brought forth a new paradigm in the allocation of capital investment [1–53].

Companies have accepted that ESG assessment plays a crucial role in reflecting their ESG performance accurately [1–10]. Investors increasingly incorporate ESG scores into their business analysis, using them as an evaluation tool to make more informed investment decisions. This shift has also prompted companies to implement ESG factors into their operational processes and investment strategies, recognizing them as key indicators of long-term success and shareholder value creation.

The expectation from investors and financial institutions on the "stakeholder values" of listed companies brings new challenges to both companies and financial markets [11–20]. The passive integration of ESG factors into the financial decision-making process has reshaped the landscape, leading to sustainability reports, ESG indices, and ratings provided by third-party authorities gaining prominence. The emergence of numerous sustainability rating agencies has further emphasized the significance of ESG in the financial landscape, underscoring the growing acceptance of ESG assessment as a critical evaluation tool for investors and companies.

As companies strive to reflect their ESG performance accurately, investors are incorporating ESG scores into their business analysis to make more informed decisions [21–30]. In response, companies recognise the importance of integrating ESG factors into their operational processes and investment strategies, understanding their correlation with long-term success and shareholder value creation.

The objective of this study is to review the literature on ESG finance based on the Scopus database and synthesize the review.

## 2. Methodology

On 21 December 2023, using the keywords 'ESG Finance', 53 papers were reached using the Scopus database, which had high relevancy. Bibliometric analyses are an established method to evaluate research literature, particularly in scientific fields benefiting from computational data treatment and witnessing increased scholarly output [56]. VOSviewer is a software that generates a clear graphical representation of bibliometric maps, especially for extensive datasets [57]. To highlight the trends of studies conducted on the topic of 'ESG Finance' from 2015–2023 (on 53 papers from the Scopus database), we performed a bibliometric analysis using the VOSviewer software (VOS stands for visualization of similarities—see www.vosviewer.com).

Scopus comprises many significant research papers and offers integrated analysis tools for creating informative visual representations [58]. VOSviewer was employed to analyze each keyword, calculating links, total link strengths, and co-occurrences with other keywords.

## 3. Results and discussion

### 3.1. Increasing number of knowledge embracing ESG finance in the literature

The connections between finance and ESG have been found in the literature [1–53] since 2015 until recently (2023). All of the papers were published between 2020 and 2023, except one in 2015 [38].

**Figure 1** gives a holistic overview of the past research based on keywords' co-occurrences with 'EGS Finance'. The analysis reveals a discernible prominence reflecting four principal domains of investigation, namely three significant clusters that can be identified based on visualization in **Figure 1** (top), such as a) sustainable development, b) sustainable finance, c) green finance, and d) green innovation. Many researchers [2019–2023] have recently focused on studies such as green innovation, commerce, ESG performance, energy use, financial systems and financial services, etc. (**Figure 1**; bottom). As an illustration, Zhang [22] examined the correlation between the advancement of green financing and the quality of enterprises' ESG performance. This analysis used a dataset that included information from many firms from 2014 to 2020. They offered a prompt evaluation of the societal significance of environmentally friendly financing in developing economies, incorporating an innovative link to ESG factors.

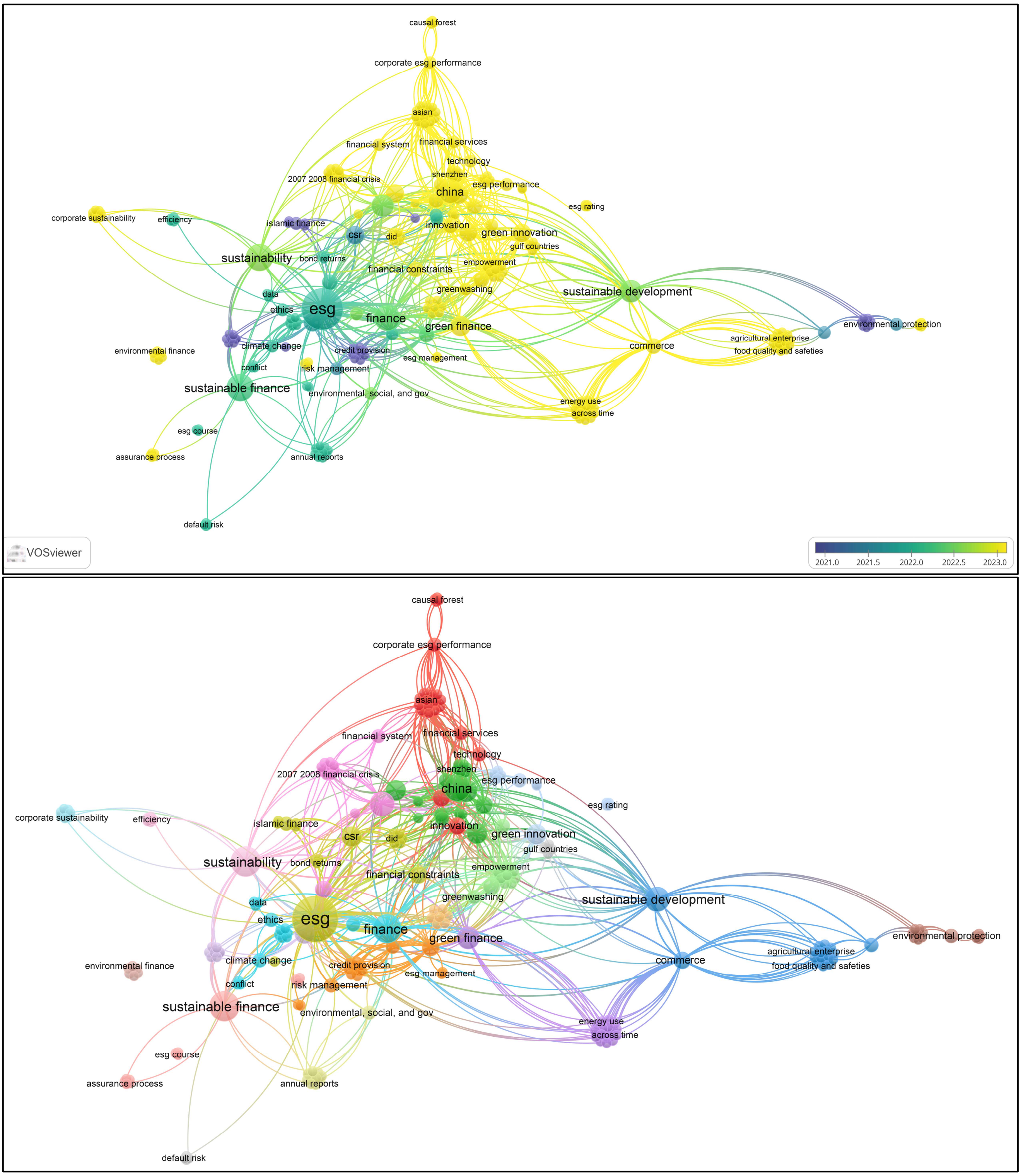


**Figure 1.** A bibliometric analysis of research themes on ESG Finance'. Top Panel: Visualization of the paper network confirming the main themes of research. Bottom Panel: Evolution of research trends between 2015 and 2023 based on the Scopus database. The colours in the top panel indicate the themes of research that the papers are discussing, while the colours in the bottom panel indicate the year of publication. N = 53 papers.

This literature hints that the ESG factor is becoming increasingly integrated into corporate strategies since it is recognized as a key indicator of a company's potential for generating shareholder value and long-term success. This shift has also led to the proliferation of sustainability reports and ESG indices and ratings provided by third-party authorities, which further emphasize the importance of ESG in the financial landscape. By incorporating ESG factors into financial decision-making, companies can effectively manage sustainability performance and meet the expectations of investors and stakeholders [54]. Moreover, the absence of standardized and mandatory micro-level ESG disclosure regulation in some markets, such as the Chinese bond market, presents challenges in accurately assessing ESG factors.

## 3.2. Advantages of embracing ESG

The advantages of embracing ESG have been indicated by many publications, highlighting the significant impact of ESG factors on investment risk and share value over time. As ESG considerations continue to gain prominence, they have become essential in assessing a company's long-term potential for sustainable value creation. Below are the three advantages of embracing ESG into corporate finance based on the literature reviewed [1–53].

### 3.2.1. Influence on financial investment decisions

Sustainable finance is generally understood as integrating ESG considerations into the investment process [44]. Investors across all asset classes increasingly integrate ESG criteria into their decision-making processes. This recognition of the influence of ESG factors on investment risk has led to a shift in mindset, where these considerations are considered crucial indicators of a company's long-term sustainability and financial performance. With a focus on environmental performance, social responsibility, and corporate governance, ESG factors have become key determinants for evaluating investment opportunities. Kim and Li [1] studied ESG and company financial performance. They examined how specific ESG categories, ESG strengths and weaknesses, and aggregate ESG factors affected business financial performance, including profitability and financial risk. They concluded that ESG aspects boost company profitability, especially for bigger enterprises. They also found that social factors affect credit ratings the most, whereas environmental scores negatively influence them. This research justifies ESG integration in investment management and portfolio creation to maximise value and minimise risk.

Bosone et al. [3] use a European company dataset to show that gender equality improves financial performance and sustainable investment. Archer [44] explained how the need to establish and quantify sustainability indicators reflects the market's rise as an ethical subject capable of making the most efficient ethical judgments. The implications for ethical intersubjectivity in sustainability are extensive.

In conclusion, this would drive sustainable investment strategies. The integration of ESG criteria within the investment decision-making process not only aligns social and environmental benefits with financial returns but also contributes to a consolidated approach to the investment strategy. By addressing environmental and social concerns, companies and investors can drive positive performance and shareholder value in the long run, leading to sustainability and long-term value creation.

### 3.2.2. Leveraging advancements in technology and innovations

Technological advancements and innovations transformed businesses and optimized numerous functional areas of financial services. Besides, green finance and fintech are also essential tools to achieve sustainable development agendas [5,7]. In the digital age, leveraging technology and data analytics can significantly enhance the assessment and monitoring of ESG factors. Advanced tools and platforms can provide real-time insights into ESG performance, allowing for more informed decision-making and proactive management of ESG-related risks and opportunities.

Wang et al. [33] used SynTao Green Finance's Chinese ESG ratings as a quasi-natural experiment to determine if ESG ratings affect corporate green innovation. They observed that ESG ratings improve green innovation quality and synergy. Thus, third-party ESG evaluations may boost corporate green innovation, helping enterprises reform and emerging markets strengthen ESG rating systems.

In a study of Chinese A-share listed enterprises from 2011 to 2020, Li and Pang [45] found that digital inclusive finance significantly improves corporate ESG performance. Still, corporate green technology innovation has a marginally increasing effect. Digitally inclusive finance may increase firms' green technology innovation, improving sustainability and ESG performance.

Ren et al. [46] examined how digital finance affects corporate ESG performance using 2011–2020 panel data from Chinese A-share listed enterprises. Three conclusions were drawn. They found that digital finance boosts corporate ESG performance, particularly environmental and social. Second, green innovation and external oversight showed that digital finance influences a company's ESG performance. Third, they found that digital finance affects enterprises with poor digitalization, profitability, regulated industries, and high carbon emissions.

Khalil et al. [5] examined innovation, green finance, financial technology, and ESG aspects in Gulf nations from 2000 to 2020 to estimate their impact on sustainable development. Policymakers and government organisations found their findings intriguing because they help strengthen governance evaluation systems and categorization criteria so nations may engage in sustainable development without obstacles.

### 3.2.3. Proactive risk management

By integrating ESG considerations into risk management frameworks, companies can proactively identify and mitigate ESG-related risks, safeguarding their long-term sustainability and resilience in the face of evolving market dynamics and stakeholder expectations. ESG risk is becoming increasingly important in ongoing environmental and social change conditions. This has specific implications for risk management in the public sector [25].

Zioło et al. [25] attempted to discover ESG elements affecting public finance using criteria in public decision-making and analyse links between public finance, ESG, risk, and efficiency. Public institutions' decision-making processes included ESG considerations, and risk, efficiency, and public finance system interdependencies were examined. Environmental issues have the greatest influence on public financial risk compared to social and governance issues. Carbon intensity emissions, which are connected to other environmental factors, are the most important. Their findings should inform government environmental policy, particularly regarding greenhouse gas reduction and climate change.

Zeng et al. [2] measured the distance to default of Chinese online financing enterprises to determine their default risk. The ESG rating was included in their evaluation approach to consider default risk concerns. The regulator can use ESG to assess default risk to raise internet finance businesses' knowledge of the environment and sustainability's value to human societies. Morgan [17] argued that corporate ESG perspectives—managing risk and/or returning anticipated value—are insufficient to account for ESG finance trends. ESG derivatives are helping cybernetic finance turn climate uncertainty into price efficiency. Pisani and Russo [36] examined the returns, volatility, and contagion risk of a sample of sustainable investment funds during the COVID-19 financial crisis.

### 3.3. Some critics and arguments

While ESG has gained significant traction in the financial sector and is being adopted by many companies, there are dissenting views on its effectiveness as a tool for sustainable investment [59]. Some critics argue that focusing on ESG factors may lead to a narrow view of company performance and profitability. They point out that while environmental and social responsibility are important, they should not overshadow traditional financial metrics crucial for evaluating a company's success.

Additionally, there are concerns about the lack of standardized and mandatory ESG disclosure regulations in specific markets, which can lead to inconsistent and unreliable ESG data. Critics suggest that comparing ESG performance across companies and industries can be challenging without uniform reporting standards [60].

Furthermore, some argue that ESG ratings provided by third-party authorities may not always reflect a company's true sustainability efforts. There is a concern that companies could engage in "greenwashing," where they overstate their ESG initiatives to score favourably on ratings without making substantial changes to their actual practices [61].

Considering these opposing viewpoints and engaging in critical discourse about the role of ESG factors in the financial sector ensures that a balanced approach is maintained and the potential limitations are thoroughly understood. Still, it is undeniable that integrating ESG factors into financial decision-making processes has redefined how companies operate and has brought about substantial changes in the allocation of capital investment. The emergence of numerous sustainability rating agencies and the popularity of sustainability reports further emphasize the significance of ESG in the financial landscape [62].

As the importance of ESG continues to grow, companies and investors must navigate the challenges posed by the absence of standardized and mandatory micro-level ESG disclosure regulations. Finding and constructing multi-dimensional ESG factors can be a complex task, and there is a need for more comprehensive and consistent reporting standards to ensure the genuineness and comparability of ESG performance across companies and industries [63].

While dissenting views on the effectiveness of ESG as a tool for sustainable investment exist, it is imperative to acknowledge and address these concerns to maintain a balanced approach [64]. This critical discourse will enable the financial sector to leverage the benefits of ESG while understanding and mitigating its potential limitations. ESG factors have become a significant consideration in environmental finance, with growing attention on their impact on company performance, industry trends, and sustainable investment strategies [65]. Investors increasingly integrate ESG criteria into their decision-making process across all asset classes, recognizing their influence on investment risk and share value over time. These factors, including environmental performance, social responsibility, and corporate governance, are crucial indicators of a company's long-term sustainability and financial performance. The growing focus on ESG factors has also incorporated these considerations into investment practices across all asset classes. Institutional investors see ESG factors as "extra-financial determinants" that hold increasing influence over the decision-making process. The impact of ESG factors on investment risk and share value over time has prompted a shift in mindset, where these considerations are viewed as essential in assessing a company's long-term potential for value creation.

The evolving focus on ESG factors has brought about significant changes in the financial sector, influencing how companies operate and allocate capital investment. This trend has also accentuated the importance of finding and constructing multi-dimensional ESG factors, overcoming the challenges posed by the absence of standardized and mandatory micro-level ESG disclosure regulation in specific markets. Efforts to address these challenges will ensure the genuineness and comparability of ESG performance across companies and industries [66].

Boiral et al. [19] investigated the value of ESG disclosure assurance in sustainable finance regulations and policies. Their study examined 188 comment letters from such players during public discussions on three new sustainable financing projects. They highlighted these players' complex and frequently critical views of external assurance's efficiency in combating greenwashing and their worries about its mandated character. These actors have raised concerns about the vagueness of verification practices, the lack of expertise in a new, specialized, and complex field, the costs of the assurance process, especially for small players, and the lack of control over ESG data reliability.

Sosa et al. [10] examined how Mexican oil prices affected two regimes. They suggested currency hedging in ESG investing. Originality comes from empirical methods and ESG index research in emerging markets. Limited information and ESG factor data are limitations. They found that tranquil and turbulent situations require distinct investing methods.

### 3.4. Research gaps

One key research gap in environmental finance under the ESG framework is the need for standardized and consistent measurement and reporting methodologies. By delving into these critical areas, the report will not only provide a comprehensive analysis of the existing gaps but will also offer actionable recommendations for advancing research and promoting the integration of ESG principles into environmental finance [67–75].

Another significant research gap in environmental finance under the ESG framework is the need for more robust and comprehensive data sources. The availability and quality of data on environmental factors, such as carbon emissions, water usage, and waste management practices, vary widely across industries and regions. This hinders the ability of investors and financial institutions to assess and compare the environmental performance of different companies accurately. Additionally, research is needed to explore the long-term financial implications of climate change and other environmental risks [71–73].

### 3.5. Implications for future research, corporate strategy, and policymaking

ESG factors have implications for future research, corporate strategy, and policymaking.

For research, environmental finance is growing in interest and popularity, and ESG opens up new avenues for research. Researchers can explore the effectiveness of different strategies and approaches to environmental finance, such as green bonds or impact investing [74]. They can also investigate the relationship between ESG practices and financial performance and the long-term implications of environmental risks for businesses [75].

For corporate strategy, environmental finance and ESG considerations can significantly influence corporate strategy [76]. Companies now recognize the importance of integrating environmental and social considerations into business operations [75]. By incorporating ESG factors into their decision-making processes, companies can identify new opportunities for sustainable growth and mitigate potential risks [74].

Environmental finance and ESG considerations can inform policymaking at different levels. Policymakers can implement regulations and incentives to encourage companies to adopt ESG practices, leading to a more sustainable and resilient economy. They can also support the development of frameworks and standards for reporting and measuring ESG performance, promoting transparency and accountability in the corporate sector. Additionally, policymakers can collaborate with financial institutions to create financial instruments and investment opportunities that support environmental initiatives [76].

Overall, the implications of environmental finance and ESG for future research, corporate strategy, and policymaking are substantial. They highlight the need for further exploration and understanding of the effectiveness and impact of environmental finance strategies [74].

### 3.6. Biases and limitations in bibliometric analysis

Bibliometric analysis is a useful tool for evaluating research output and impact. However, it is important to acknowledge that there are potential biases in the selection of literature and limitations to consider when conducting bibliometric analysis. Some potential biases in the selection of literature for bibliometric analysis include language bias, publication bias, and accessibility bias [77].

Publication bias in bibliometric analysis refers to the tendency for studies with positive or significant results to be published. At the same time, those with negative or non-significant findings are often left unpublished. This can lead to overestimating certain research outcomes and impact the validity of bibliometric analyses. Addressing publication bias requires careful consideration of strategies such as searching for unpublished literature, including grey literature, and incorporating methods to evaluate the impact of publication bias on the results [78,79].

Accessibility bias in bibliometric analysis arises from limitations in accessing certain types of literature, such as books, conference proceedings, and non-mainstream publications. Overcoming accessibility bias involves expanding search methods to include diverse literature sources, considering the inclusion of different publication types, and utilizing tools that facilitate comprehensive literature searches [80,81].

### 3.7. Practical applications for investors, companies, and policymakers

Implementing environmental finance under ESG has practical applications for investors, companies, and policymakers.

Environmental finance under ESG allows investors to align their investment strategies with sustainability goals. This can involve investing in companies that prioritize environmental conservation, promote social equity, and adhere to strong governance practices. Companies can benefit from environmental finance under ESG by integrating these principles into their business models. This can lead to improved financial performance, increased investor interest, and an enhanced reputation [76]. Additionally, policymakers can be crucial in encouraging companies to adopt ESG practices through regulation and incentives. By implementing and enforcing ESG regulations, policymakers can help create a level playing field and incentivize companies to adopt sustainable practices. Overall, the practical applications of environmental finance under ESG are wide-ranging.

## 4. Conclusion

In conclusion, the evolving focus on ESG factors has brought about significant changes in the financial sector, influencing how companies operate and allocate capital investment. This trend has also accentuated the importance of finding and constructing multi-dimensional ESG factors, overcoming the challenges posed by the absence of standardized and mandatory micro-level ESG disclosure regulation in specific markets. Efforts to address these challenges will ensure the genuineness and comparability of ESG performance across companies and industries.

On the plus side, embracing ESG factors in investment decisions is a critical step towards sustainable growth and value creation. The ongoing integration of ESG criteria will continue to shape the financial sector, influencing how companies operate, allocate capital investment, and ultimately contribute to long-term sustainable development. In summary, the evolving ESG landscape presents both opportunities and challenges for companies and investors. Embracing transparency, leveraging technology, fostering collaboration for standardization, promoting education and awareness, and integrating ESG into risk management are essential components of navigating this landscape and realizing the full potential of ESG for sustainable growth and value creation.

As the financial sector continues to navigate the complexities and potential limitations associated with integrating ESG factors, it becomes increasingly important to maintain a balanced approach. Critical discourse and a thorough understanding of dissenting viewpoints will enable companies and investors to leverage the benefits of ESG while addressing and mitigating its potential limitations. By acknowledging and addressing the concerns raised by critics, the financial sector can ensure that ESG factors are used effectively for sustainable investment, ultimately contributing to long-term value creation and sustainable growth. In essence, integrating ESG factors into investment decisions not only aligns social and environmental benefits with financial returns but also contributes to a consolidated approach to the investment strategy that drives positive performance and shareholder value in the long run.

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