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From ESG to Sustainable Development: A Path Designed for the Triple Helix Spheres

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This work employs content analysis and a technical–scientific scenario method to propose a framework with recommendations for promoting sustainable development through environmental, social, and governance (ESG) initiatives, specifically designed for the triple helix spheres (government, business, and academia).

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ABSTRACT

This work examines the relationship between environmental, social, and governance (ESG) initiatives and sustainable development (SD), highlighting a scientific gap in their effective connection. It aims to propose a framework with recommendations for promoting SD through ESG, considering the governmental, business, and academic spheres from the triple helix (TH) perspective. This framework provides guidelines for public policies, corporate practices, and scientific research, fostering a sustainable balance between the economy, society, and the environment. Using the scientific methods of content analysis and technical–scientific scenario, various sources were analyzed, including patents, legislation, corporate reports, and scientific articles from leading ESG countries. Its findings indicate that the strategic implementation of ESG enhances public governance, strengthens corporate competitiveness, and drives academic innovation. Theoretically, this work articulates ESG and TH to advance SD theory. Practically, it enables governments, businesses, and academia to promote SD in an integrated manner.

1 | Introduction

Companies must adopt environmentally responsible, socially inclusive, and transparent business models to align with socially responsible investment (SRI) practices and drive sustainable development (SD) (Folqué et al. 2021; He et al. 2024; van Bommel et al. 2023). Stock exchanges are increasingly requiring transparency about companies' environmental, social, and governance (ESG) impacts and initiatives, compelling firms to report strategies and policies that mitigate risks and foster socio-environmental balance (Chen, Mao, and Gao 2023; Crace and Gehman 2023; Yang et al. 2024). Thus, when widely

adopted in one territory, either for legal reasons or to attract investors, such initiatives create virtuous cycles that reinforce SD outcomes (Jyoti and Khanna 2021; Nunhes et al. 2021; Singh and Kumar 2024). For this reason, beyond financial markets, governments and civil society increasingly expect companies to meet higher standards of transparency and responsibility (Dremptic et al. 2020; Fu 2023; Wang, Qi, and Zhuang 2023), often reinforced by regulation (Aboud et al. 2024; Chen, Mao, and Gao 2023; He et al. 2024).

ESG has also attracted the attention of the academic community. Dremptic et al. (2020), Xie et al. (2019), and Yang et al. (2024)

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analyzed its relationship with the financial sustainability of companies. Gillan et al. (2021) and Minkinen et al. (2022) related ESG to SRI. Chen, Khurram, et al. (2023), Folqué et al. (2021), and Khan et al. (2020) validate the contribution of ESG practices to SD, highlighting the increase in regional technological capacity and investments in green innovation. Although Shalhoob and Hussainey (2023) advocate that small and medium-sized companies also adopt ESG practices to collectively contribute to sustainability in the countries where they operate, and Kuzey et al. (2023) point out the importance of strengthening government oversight to ensure the information's reliability and mitigate the risk of greenwashing.

Although these studies have explored the effects of ESG on companies, do Prado et al. (2020), Aboud et al. (2024), and Huang (2024) indicated a research gap on the need to better understand how ESG initiatives can promote SD. This work intends to fill this gap by answering the following research question: "How can ESG initiatives drive SD?". To answer it, it aims to propose a framework containing recommendations for promoting SD through ESG initiatives, considering the government, business, and academic spheres from the perspective of the triple helix (TH) model.

To this end, a combination of two scientific methods was used: "content analysis (CA)" and "technical-scientific scenario (TSS)". CA allows the systematic exploration and interpretation of the information collected, and TSS enables a panoramic view by merging information from varied scientific and empirical sources, such as academic articles, legislation, business reports, and so forth. (Cronin and George 2023; do Prado et al. 2020; García-Sánchez et al. 2022). In addition, the TH model, which involves governments, business, and academia, was used to structure the mapping of the TSS of ESG, enhancing the results from the interrelationship between these spheres (Teixeira Dias et al. 2023). Thus, the ESG initiatives proposed in this framework have the potential to improve the management of resources, social practices, and institutional transparency of governments and companies; increase the competitiveness, governance, and public image of companies; and foster academic research and ESG practices of educational institutions and scientific funding agencies.

2 | Theoretical Background

The concept of SD, as defined in the Brundtland Report, entails meeting present needs without compromising the ability of future generations (Drempetic et al. 2020; Friedrich 2023). Achieving this balance requires coordinated cross-action among governments, companies, and academia, which aligns with the TH model concept of collaboration between the TH's three spheres to advance SD (Aboud et al. 2024; Kuzey et al. 2023; Miralles-Quirós et al. 2019). Building on this premise, ESG refers to the set of corporate practices and disclosure mechanisms designed to integrate socio-environmental responsibility and governance standards into business strategies for achieving corporate sustainability (CS) (Crace and Gehman 2023; Huang 2024; Siao et al. 2022). Complementarily, stakeholder theory argues that firms should align their strategies with the interests of multiple groups

beyond shareholders, including employees, consumers, governments, and communities, contrasting with the traditional shareholder-centric approach (Peng and Isa 2020). According to this theory, companies should tie their interests to stakeholders' demands (Nirino et al. 2021). Together, these constructs provide the theoretical basis for this study, which integrates ESG initiatives, stakeholder engagement, and TH dynamics to examine pathways for achieving SD.

Through this perspective, ESG also empowers the financial market to promote SD, as investors prioritize companies that transparently disclose their impacts and adopt strategies for environmental protection, social equity, and corporate integrity (Boudawara et al. 2023; Chen, Mao, and Gao 2023). Investors, whether individuals or institutional groups, rely on this information to build portfolios by acquiring assets through asset managers, such as banks, companies, or insurance firms (García-Sánchez et al. 2022; He et al. 2024; Khan et al. 2024). These assets, referred to as Assets Under Management (AUM), are traded on stock exchanges, either individually or via Exchange Traded Funds (ETFs), which can focus on specific themes or indices analyzed by specialized agencies like MSCI, S&P, and Bloomberg (Boudawara et al. 2023; Drempetic et al. 2020; Yang et al. 2024).

To be eligible for trading, companies must ensure their reports are audited by at least one of the Big Four auditing firms (Deloitte, EY, KPMG, or PwC), which specialize in financial, legal, and accounting oversight (Gillan et al. 2021; Kolsi et al. 2023). These audits rank companies based on their financial and ESG performance, incentivizing asset managers to include high-performing firms in ETFs where ESG serves as a key differentiator (Chen, Mao, and Gao 2023; Kolsi et al. 2023). The results of ESG-focused ETFs have demonstrated significant advantages for both investors and companies, enhancing corporate resilience, reducing risks, increasing valuation, and ultimately boosting financial performance and return on investment (Albitar et al. 2023; Pedersen et al. 2021). This interconnected process of ESG asset trading is illustrated in Figure 1.

Building on the strategic role of ESG in achieving CS, various factors influence the relationship between ESG practices and the financial performance of companies. Among these, the diversity of the board of directors stands out, particularly the inclusion of women in participatory roles, which enhances decision-making and governance (Albitar et al. 2020; Eliwa et al. 2023). Additionally, the autonomy of CEOs from the board of directors in disclosing ESG-related information plays a critical role in ensuring the integrity of these reports (Crace and Gehman 2023; Li et al. 2018). Other significant factors include CEO compensation structures (Chen, Mao, and Gao 2023; Crace and Gehman 2023), transparency in published information (Buallay 2019; He et al. 2023), and the establishment of ESG committees to plan and oversee corporate practices (Zhao et al. 2018). Investments in green innovation further strengthen a company's commitment to sustainability, while active development and engagement of CEOs and boards in ESG initiatives enhance organizational alignment with these principles (Chen, Mao, and Gao 2023; Tan and Zhu 2022; Gillan et al. 2021). Moreover, robust governance practices, supported by public policies designed to standardize and monitor ESG efforts, contribute significantly to the long-term impact of these initiatives

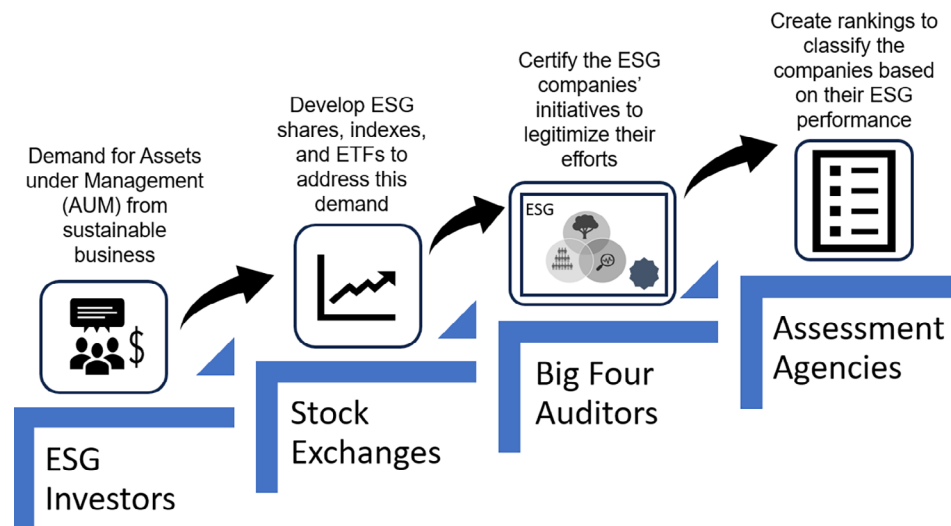


FIGURE 1 | The ESG workflow in financial markets.

(Albitar et al. 2023; Azmi et al. 2021; Gregory 2022). Pressure from institutional investors and large shareholders also acts as a catalyst, encouraging companies to prioritize ESG practices that improve both their sustainability outcomes and financial performance (Ahmadova et al. 2023; García-Sánchez et al. 2022; Wang, Fan, and Zhuang 2023).

Despite the growing prominence of ESG as a tool for sustainability, significant challenges persist regarding its effectiveness and authenticity, often leading to a disconnection between expected and actual results (Giupponi et al. 2025). The most notable hurdle is greenwashing, which refers to companies disclosing extensive ESG data to manage stakeholder perceptions while their actual performance is poor (Sun et al. 2025). This phenomenon is enabled by a lack of reliable metrics and standardized indicators, making it difficult to measure the true depth of ESG initiatives and to distinguish “cosmetic” practices from genuinely transformative ones (Giupponi et al. 2025; Luque-Vílchez et al. 2023).

Although these hurdles need to be overcome, this background positions ESG as a bridging mechanism between the systemic collaboration proposed by the TH model and the multi-actor orientation of stakeholder theory, both directed toward the overarching objective of SD. By aligning these perspectives in a framework in which ESG initiatives can be operationalized, it mobilizes the TH spheres to respond to the demands of civil society and investors.

3 | Research Method

This work combined two scientific methods: CA and TSS. CA was applied because it allows interpreting, compiling, and abstracting qualified knowledge from diverse sources (Horne et al. 2020; Nunhes et al. 2020). TSS, in turn, is an innovative yet validated method that offers a solid foundation for understanding ESG-related technical and scientific developments, while addressing the complexity of SD (de Oliveira et al. 2024). The adoption of the TSS method is justified by its innovation and superiority over traditional methods, which, when used

in isolation, are unable to fully address the complexity of the object of study (Costa et al. 2022). Unlike purely bibliometric analyses or conventional integrative reviews, the TSS method rigorously and deeply combines qualitative and quantitative evidence extracted from multiple sources, such as academic literature, patents, reports, public policies, and funding programs, thus enabling a broad and applicable analysis of the topic (Rocha et al. 2024).

Anchored in the TH model, TSS allows for a structured examination of interactions between government, industry, and academia, ensuring scientific rigor, practical relevance, and social impact in the ESG context (Cai and Etzkowitz 2020; Jyoti and Khanna 2021; Teixeira Dias et al. 2023). This framework enabled the exploration of ESG initiatives, revealing how the TH spheres can align to foster more innovative and sustainable practices (Cai and Lattu 2022). Figure 2 shows the development flow of the work, outlining the process stages.

In Stage 1, it was decided that the ESG's TSS would be the basis of the work. Next, the research gap was identified, formulating the question, objective, and scientific method. To directly address the research question, this work relies on a qualitative design. Rather than testing a deductive theoretical model, the combined use of CA and the TSS methods provides a structured pathway to map, interpret, and synthesize international ESG practices, ensuring that it follows a structured procedure, thereby providing a grounded response to the research question.

Stage 2 involved selecting databases, including Lens for technical analysis (patent data) and Scopus for scientific analysis. The MSCI ESG Leaders index was used to identify leading ESG companies, while the StartupBlink website provided insights into startup ecosystems. Complementary data were sourced from government, corporate, and academic websites.

Using Lens, countries with the highest number of ESG-related patents were identified through a search query by applying the terms “ESG” or “environmental, social and governance”, with at least one of the following terms: “sustainability”, “sustainable development”, “corporate social responsibility”, “CSR”, “Performance”,

“disclosure”, “reporting”, “stakeholder”, “investment”, “financial”, “assessment” or “economic”. The analysis focused on patents from National, Global (WO), and European (EP) registrations, resulting in the selection of the five leading countries: the United States (USA), South Korea, China, Japan, and the United Kingdom (UK).

For academic data, Scopus was chosen for its reliability, abundance of documents on the topic, and analytical tools (Khan 2022; Passas et al. 2022). Using the same search query, 2427 documents were retrieved, narrowed to 1887 after inclusion criteria (publication years—from 2018 up to 2023; document type—articles/reviews; and language—only English). Then the countries were ranked by *h*-Index, which indicated the top five were the USA, Italy, the UK, China, and Malaysia. An average ranking of patent positions and *h*-Index scores led to the selection of the USA, China, and the UK for further analysis, as shown in Figure 3.

To select ESG reports, the MSCI ESG Leaders index was referenced, focusing on companies with the highest scores, based on their ability to manage ESG risks and opportunities while excluding those with controversial exposures (MSCI 2024). For startups, the StartupBlink platform, recognized by the World Economic Forum, guided the identification of relevant organizations (Guerrini 2015; WEF 2024).

In Stage 3, data were organized by country and presented in tables detailing the ESG TSS and TH spheres, followed by an

in-depth analysis in Section 4. Stage 4 culminated in the development of a framework offering recommendations for ESG development in the selected countries, as depicted in Figure 4.

These recommendations, elaborated in Section 5, are the result of the authors' knowledge, based on the scientific literature on ESG and the best practices observed in the TH spheres of the countries analyzed. Finally, Stage 5 concludes the study, summarizing contributions and limitations in Section 6.

4 | Technical and Scientific Scenario of ESG

Mapping the TSS of ESG involves identifying the main initiatives carried out in the countries with exemplary ESG performance, based on the analysis criteria outlined in the research method (Figure 3). From this analysis, the USA, China, and the UK were selected for this study due to their advanced technological, governmental, and scientific developments in ESG-related aspects.

4.1 | United States

The USA emerged as a leader in ESG performance according to this study's criteria, ranking highest in both the number of patents registered and the *h*-Index among the countries analyzed.

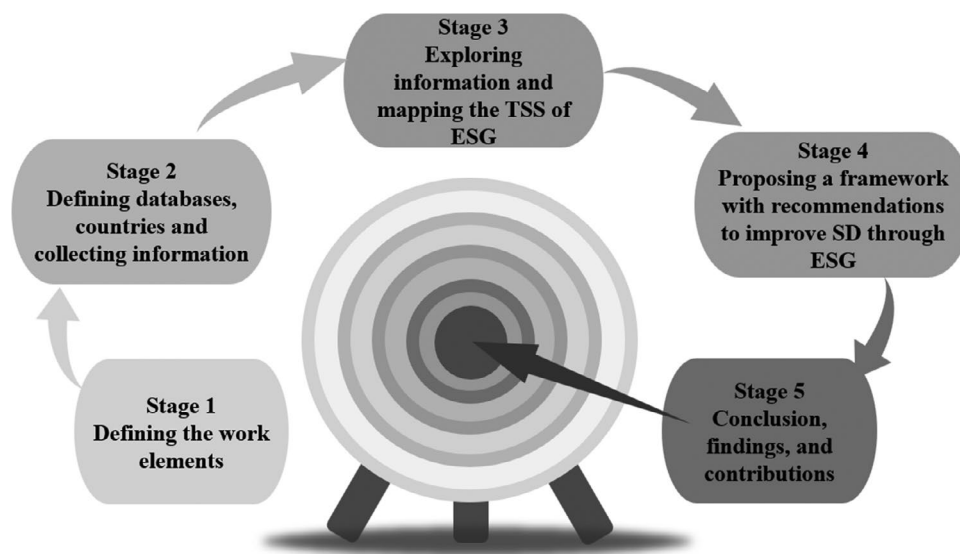


FIGURE 2 | Development flow of the work.

#	Country	Patent	#	Country	Document	H-Index	Country	Patent	H-Index	Average	#
1	USA	361	1	USA	247	34	USA	361	34	197,5	1
2	South Korea	59	2	Italy	179	34	China	39	30	34,5	2
3	China	39	3	United Kingdom	160	31	United Kingdom	9	31	20	3
4	Japan	29	4	China	462	30	Italy	0	34	17	
5	United Kingdom	9	5	Malaysia	100	19	Malaysia	0	19	9,5	
							South Korea	59	0	29,5	
							Japan	29	0	14,5	

FIGURE 3 | Ranking of the selected countries.

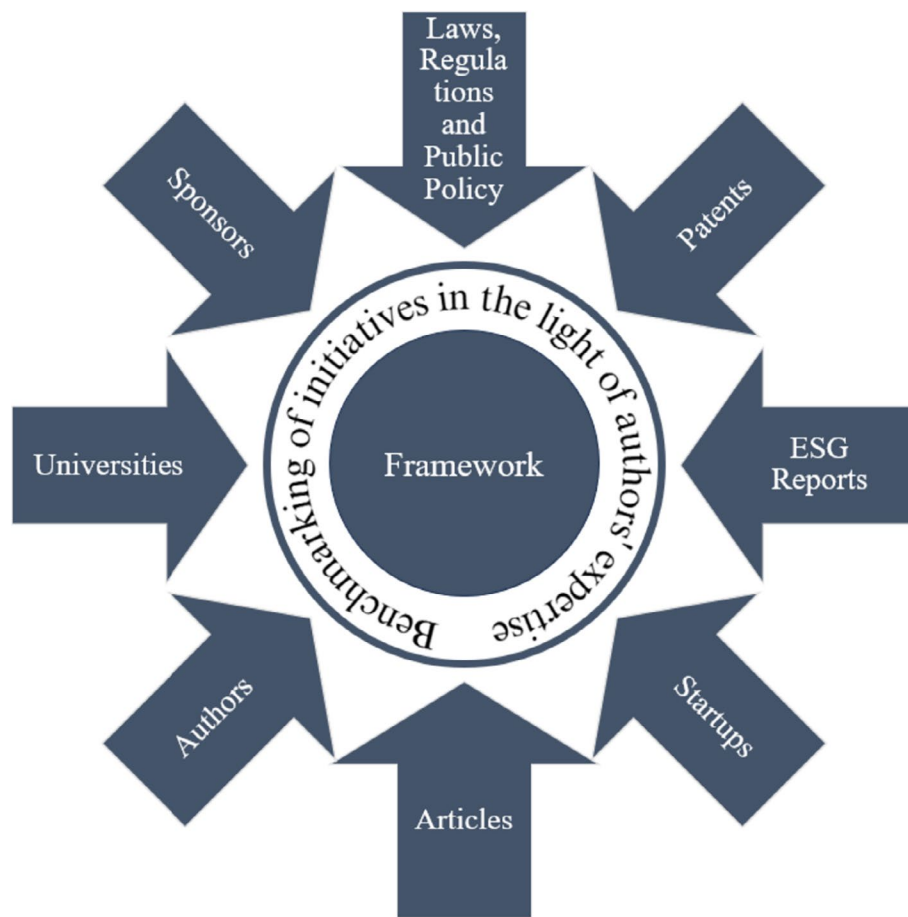


FIGURE 4 | Framework development.

This leadership can be attributed to three main factors: the first is the strong presence of institutional investors in the financial market, who wield significant influence over corporate strategies and practices and are widely aligned with the principles of responsible investment (PRI). Over 80% of these investors consider ESG information a key factor in decision-making (Amir and Serafeim 2018; Fatemi et al. 2018; Gillan et al. 2021). The second factor is the autonomy of individual states to legislate, which impacts corporate compliance with ESG standards. This autonomy allows for diverse and rigorous regulations, such as California's mandate for companies to disclose carbon emissions (Khan et al. 2024). The third factor is the contribution of researchers and universities, which actively integrate ESG principles into their practices and funding structures. American researchers are particularly recognized for advancing ESG knowledge and fostering a strong commitment to sustainability and social responsibility, as highlighted in Table 1 (the complete analysis is available in Appendix 1).

In the USA tech scene, although the government has advanced SD regulations on ESG pillars, the financial system still faces resistance in some states, where investors argue that such initiatives could compromise the fiduciary duty to maximize returns (Ross 2023). Consequently, some states have enacted “anti-ESG” legislation, imposing sanctions on companies that adopt practices like boycotting fossil fuels or promoting gender diversity (Engler 2024). These regulations create barriers for ESG initiatives, particularly for companies needing to align

with requirements in foreign financial markets (Ross 2023; Engler 2024).

In the business sphere, an analysis of USA patents related to ESG revealed important innovations: one patent uses historical data to predict behavior and mitigate risks for investors; another enables ESG-focused investors to accurately assess companies' sustainability activities through modular segmentation; a third patent allows organizations to gauge public opinion on their practices, providing opportunities to refine ESG policies, practices and reporting (Fu 2023).

The MSCI USA ESG Leaders Index, comprising 300 large and medium-capitalization companies, was used to select ESG reports for analysis. In this index, the Information Technology sector accounts for 36.61% of the total, with the three analyzed companies representing approximately 29% of the index (MSCI 2024). The ESG reports released by the companies analyzed showed that Microsoft used the Global Reporting Initiative (GRI) guideline for its 2024 report (Microsoft 2024). NVIDIA adopts a more comprehensive approach, combining GRI, Sustainability Accounting Standards Board (SASB), Task Force for Climate-Related Financial Disclosures (TCFD), and United Nations Sustainable Development Goals (UN SDG) frameworks to address all material ESG assessment points (NVIDIA 2024). Similarly, Alphabet, which oversees Google, uses SASB and TCFD guidelines for its ESG indices, with internal assessments for improvement and GRI for environmental metrics.

TABLE 1 | ESG's technical–scientific scenery in the USA.

Topic	ESG initiatives		References
	Technical scenery		
Government			
Laws, regulations, and public policy			
LRPP 1	Implementing high-impact sustainable actions		US Gov. (2024)
LRPP 2	Regulate laws that include the consideration of ESG factors to manage public funds		LegiScan (2023)
LRPP 3	Encouraging the female workforce to collaborate with technological development and innovation		LegiScan (2024)
Enterprises			
Patents			
Patent 1	Create an ESG performance trend analysis dashboard for investors		Lens (2024)
Patent 2	Develop an interactive system for investors		Lens (2024)
Patent 3	Create systems and methods to determine the perception of public opinion concerning the impacts of entities and industries activities		Lens (2024)
ESG reports			
Report 1	Defining targets to promote sustainability internally and globally aligned with the United Nations (UN) 2030 Agenda		Microsoft (2024)
Report 2	Using generative AI to optimize resources, increase productivity and generate sustainability		NVIDIA (2024)
Report 3	Using AI technology to drive positive environmental changes		Alphabet (2024)
Startups			
Startup 1	Employ innovative technology to convert carbon dioxide captured from the atmosphere or industrial facilities into sustainable products		Dimensional (2024)
Startup 2	Expanding financial access to support communities in need		Kiva (2024)
Startup 3	Automate cloud permissions to optimize cyber security and productivity for companies		Entitle (2024)
Scientific scenery			
Academia			
Articles			
Article 1	To explore how ESG factors influence market value		Gillan et al. (2021)
Article 2	To identify the motivation and difficulties of investors in financial markets		Amir and Serafeim (2018)
Article 3	To identify how the number of shareholders and the presence of a CSR committee affect ESG reporting		Fatemi et al. (2018)
Articles			
Author 1	Examining MSCI's ESG metrics to improve corporate policies		Eccles et al. (2020)
Author 2	To analyze the individual impact of ESG pillars on corporate results during crises		Gregory (2022)
Author 3	Develop a sustainable product pricing method that allocates appropriate costs to each ESG aspect		Khan et al. (2024)
Universities			
University 1	Implement practices to strengthen ESG at the university		Fordham (2022)

(Continues)

TABLE 1 | (Continued)

Scientific scenery		
University 2	Disseminate and apply sustainable practices to integrate the university with the local community	ETSU (2024)
University 3	Encouraged students to solve real ESG problems in partnership with local companies	Penn (2024)
Sponsors		
Sponsor 1	Use the ESG pillars as a condition for approving projects	Gates Foundation (2024)
Sponsor 2	To direct its resources to projects that promote human well-being, committed to ESG principles	Rockefeller Foundation (2024)
Sponsor 3: Govern Institution	Integrate ESG principles into the projects and operations it finances	DHS (2024)

Alphabet also updates its results quarterly on digital platforms (Alphabet 2024).

The United States also leads in startup activity, with ecosystems in cities such as San Francisco, New York, and Boston fostering innovations aligned with ESG. Examples include ventures focused on renewable energy, digital transparency, and inclusive finance (StartupBlink 2024; Peachman 2024).

In the academic sphere, several initiatives stand out: Fordham University's partnership with SASB to develop ESG courses (Fordham 2022), while East Tennessee State University offers a Sustainability Education program (ETSU 2020) and the University of Pennsylvania has established research centers focused on climate change, corporate governance, ethics, and impact investments (Penn 2024). Beyond institutional efforts, research funding bodies in the USA have increasingly incorporated ESG criteria into their project evaluations, prioritizing environmental challenges such as climate change and water access, alongside social issues like public health and gender equity. By aligning funding priorities with ESG principles, these efforts drive clean technology development, support education and female empowerment, and promote integrity and transparency in governance (DHS 2024; Gates 2024). A standout initiative is the Global Energy Alliance, funded by the Rockefeller Foundation. This program supports renewable energy development in over 80 countries, leveraging private capital to accelerate the energy transition in developing nations. It aims to expand energy access, reduce carbon emissions, and promote smart, sustainable technologies (Rockefeller 2024).

4.2 | China

China ranks as the second country in ESG performance according to the criteria of this study, reflecting its strong position in patents and *h*-Index scores. However, as a major global producer, China faces significant pressure to reduce carbon emissions and implement policies that align corporate strategies with sustainable development goals (SDG) (Ahmed et al. 2020; Chen and Xie 2022; Zhao et al. 2018). To address these challenges, the

China Securities Regulatory Commission (CSRC), with support from the Asset Management Association of China (AMAC), has mandated ESG disclosure for listed companies through initiatives such as the 'Green Investment Guidelines and ESG Evaluation System' (Chen, Khurram, et al. 2023; Lu et al. 2022). Despite these efforts, the lack of comprehensive national regulations for ESG disclosure and media coverage remains a concern, potentially leading to distortions or favoritism in the interpretation of ESG reports (He et al. 2024).

The Chinese government has also prioritized technological innovation as part of its Five-Year Plan, aiming to transition from "Made in China" to "Created in China" while achieving sustainability goals (Khan et al. 2020; SUFE 2023). To support this shift, many companies rely on external financing, with Chinese banks requiring ESG reporting as a condition for loans (Chen, Khurram, et al. 2023). However, the absence of mandatory auditing by one of the Big Four firms compromises the reliability of these reports (He et al. 2024; Zheng et al. 2022). In response, publicly traded companies are increasingly focusing on green innovation and enhancing their ESG practices to improve ratings and strengthen strategies (Chen and Xie 2022; Tan and Zhu 2022).

Universities in China have played a crucial role in advancing ESG, fostering collaboration between government, business, and academia through forums, development programs, and action plans, as shown in Table 2 (for more details, see the complete analysis in Appendix 2).

The government has further supported ESG development by promoting a 'Green Financial System' since 2016, in collaboration with ministries and commissions like the CSRC. This system aims to ensure that listed companies contribute to SD while maintaining operational quality. To this end, stock exchanges in Shanghai, Shenzhen, and Hong Kong have also issued specific ESG disclosure guidelines for listed companies (CNPC 2023; SISD 2023).

In the business sphere, patents in China reveal innovative applications focused on the financial sector. For instance, one patent

TABLE 2 | ESG's technical–scientific scenery in China.

Topic	ESG initiatives	
	Technical scenery	References
Government		
Laws, regulations, and public policy		
LRPP 1	Enact laws for companies that promote ESG through ecological and innovative investments	CNPC (2023)
LRPP 2	Encourage and promote development of service providers for industries	GPMX (2024)
LRPP 3	Structure an ESG Acceleration Field to leverage SD	SISD (2023)
Enterprises		
Patents		
Patent 1	Create a management system and method to connect companies and investors in ESG projects	Lens (2024)
Patent 2	Develop an ESG data management and storage system for investors using IoT	Lens (2024)
Patent 3	Create a Blockchain-based ESG platform to guide banks and investors in sustainable decisions	Lens (2024)
ESG reports		
Report 1	Developing programs with a social and environmental impact, using AI	Tencent (2024)
Report 2	Implement rural development assistance programs	CCB (2024)
Report 3	Applying generative AI to reduce production costs in small and medium-sized businesses	Alibaba (2024)
Startups		
Startup 1	Developing intelligent driving solutions for human safety	Horizon (2024)
Startup 2	Eliminating intermediaries to improve food services sector.	Meicai (2024)
Startup 3	Promoting innovative solutions for smart cities and companies	Yitu (2024)
Scientific scenery		
Academia		
Articles		
Article 1	Create an ESG agenda for companies, by comparing their actual performance with the global average for their sector	Zhao et al. (2018)
Article 2	To identify how ESG practices promote green innovation in companies	Tan and Zhu (2022)
Article 3	Develop an ESG monitoring dashboard for listed companies	Chen and Xie (2022)
Authors		
Author 1	Analyze the impact of the media on companies' ESG decisions	He et al. (2024)
Author 2	Study how ESG disclosure contributes to companies' technological innovation capacity (TIC)	Chen, Khurram, et al. (2023), Chen, Mao, and Gao (2023)
Author 3	Investigate how digital transformation influences ESG performance	Yang et al. (2024)
Universities		
University 1	Create opportunities to increase dialogue between governments, companies and academia to increase ESG	CUEB (2023)
University 2	Create an Action Plan for ESG development at the university	XJTU (2024)

(Continues)

TABLE 2 | (Continued)

Scientific scenery		
University 3	Draw up projects to expand and improve the ESG based on the profile and needs of local companies	SUFE (2024)
Sponsors		
Sponsor 1	Promoting international scientific collaboration through the <i>Science Fund for Global Challenges and Sustainability</i>	NSFC (2024)
Sponsor 2	Assisting in the selection of projects related to ESG issues	NOPSS (2024)
Sponsor 3	Create specialization and innovation in critical areas to promote sustainability	MOE-CN (2024)

connects investors to ESG projects, such as clean energy transitions and carbon emission reductions. Another uses Internet of Things (IoT) technology to assess companies' performance based on ESG scores, reducing investment risks. A third patent leverages blockchain technology to ensure security, transparency, and credibility in green certifications for companies involved in sustainable energy.

The MSCI China ESG Leaders Index, consisting of large and medium capitalization companies, highlights the non-essential consumer goods sector, which accounts for 28.22% of the index (MSCI 2024). Among the three companies analyzed, Tencent applies a broad range of guidelines, including GRI, SASB, TCFD, UN SDG, the Hong Kong Stock Exchange ESG Guide, IFRS, and TNFD, to address materiality topics (Tencent 2024). CCB follows IFRS and Hong Kong Stock Exchange standards (CCB 2024), whereas Alibaba adopts a similar approach to Tencent, excluding IFRS and TNFD in its 2024 ESG report (Alibaba 2024).

China has also advanced in startup ecosystems, ranking 13th globally, with Beijing (6th) and Shanghai (7th) among the top 10 cities for startup activity (StartupBlink 2024).

In academia, initiatives are advancing ESG integration. Academics like Feng He have been recognized in Tianjin for their research on ESG, innovation, and corporate social responsibility. Their work demonstrated how high-quality ESG practices improve governance and reduce ethical issues like corruption (He et al. 2022). Other studies have linked high-quality ESG reports to digital transformation, showing that financial digital inclusion enhances corporate transparency and credibility, facilitating access to financial resources (Lu et al. 2022; Yang et al. 2024). To further strengthen ESG education, the Capital University of Economics and Business (CUEB) established China's first ESG Research Institute, which developed the "Corporate ESG Disclosure Guide"—the nation's first comprehensive standard addressing core ESG and sustainability issues. CUEB also launched the first Corporate Sustainability Department, preparing professionals in ESG theory, investment technologies, and implementation strategies (CUEB 2023). Additionally, the Shanghai University of Finance and Economics inaugurated the country's first ESG Innovation Forum in 2023 to drive ESG development (SUFE 2023).

4.3 | United Kingdom

The UK ranks third in this study, which relates patents to the *h*-Index. Until 2020, the UK was part of the European Union (EU), adhering to many shared guidelines with other member countries (Aboud et al. 2024; Umar et al. 2020). Even post-Brexit, the UK has retained certain connections, such as the adoption of Directive 2014/95, which mandates ESG reporting for large companies listed on EU member state stock exchanges (Aboud et al. 2024; Taliento et al. 2019). This Directive strategically enhanced the consistency and transparency of corporate ESG information and standardized reporting across countries, allowing companies to adopt recognized frameworks such as the GRI and OECD guidelines (Cordazzo et al. 2020). However, each country remains responsible for developing its own legislation and enforcement mechanisms (Aboud et al. 2024).

The UK's collaboration with the EU also extends to ESG research, funded by the European Commission and the European Research Council. A notable example is the "Soil Deal for Europe" project launched in 2023, which allocated 90 million euros to restore soil health across 32 countries, including the UK (European Commission 2021). In addition to European funding, the University of Birmingham has emerged as a significant ESG research funder within the UK. Many British universities, particularly larger institutions, have committed to the 2030 Agenda and integrated ESG principles to become sustainability benchmarks. Additional UK initiatives are detailed in Table 3 (all details and the complete analysis are available in Appendix 3).

At the government sphere, the UK has implemented its own ESG reporting regulations inspired by the EU Directive 2014/95. These rules require large companies operating within the UK, including subsidiaries of foreign corporations and public organizations, to disclose their ESG practices (GOV.UK 2024). This approach ensures comprehensive implementation and reporting of ESG initiatives by all significant entities within the country.

In the business sphere, the UK's connection with the EU is evident in patent registrations and the MSCI ESG index, as shown in Table 3. Among the analyzed patents, one enables managers to prioritize material ESG issues and provides diagnostics for each. Another leverages Machine Learning via web scraping to collect and monitor ESG data from preselected online sources, offering dynamic updates to facilitate investor decision-making.

TABLE 3 | ESG's technical–scientific scenery in the UK.

Topic	ESG initiatives	
	Technical scenery	References
TH sphere—government		
Laws, regulations, and public policy		
LRPP 1	Extend the obligation to disclose ESG information to large companies in all economic sectors	GOV.UK (2024)
LRPP 2	Develop ESG-based government strategies to promote sustainability in agribusiness	GOV.UK (2024)
LRPP 3	Increase climate resilience and plan for long-term solutions to maintain the government's operational capacity.	GOV.UK (2024)
TH sphere—enterprises		
Patents		
Patent 1	Develop administration software to manage ESG aspects in companies	Lens (2024)
Patent 2	Create a system that uses machine learning to process ESG information	Lens (2024)
Patent 3	Developing a program that unifies different ESG metrics	Lens (2024)
ESG reports		
Report 1	Utilize the product portfolio to promote equitable access to healthcare	AstraZeneca (2024)
Report 2	Broadening the access of small and medium-sized companies to opportunities related to sustainability.	HSBC (2024)
Report 3	Create mechanisms to guide, support and monitor the supply chain to improve their sustainability	Unilever (2024)
Startups		
Startup 1	Support organizations to invest in sustainable environmental markets, offering knowledge and tools for climate decisions	BeZero (2024)
Startup 2	Providing support for organizations in terms of regulatory compliance	Novatus (2024)
Startup 3	Provide vertical farming systems by using cutting-edge technologies	Vertical (2024)
Scientific scenery		
TH sphere—academia		
Articles		
Article 1	Analyze the impact of the influence of CEOs on ESG reporting on company value	Li et al. (2018)
Article 2	Examine the ideal ESG investments for different investor profiles (carefree, worried and motivated)	Pedersen et al. (2021)
Article 3	Study how micro and macroeconomic factors influence ESG performance and financial results	Buallay (2019)
Authors		
Author 1	Develop guidelines for implementing ESG in Small and Medium-Sized Enterprises (SMEs)	Shalhoob and Hussainey (2023)

(Continues)

TABLE 3 | (Continued)

Scientific scenery		
Author 2	Examine how the narrative of ESG reports affects stakeholders and business results	Albitar et al. (2023)
Author 3	Analyze the impact of mandatory ESG disclosure on data accuracy in comparison with the real impacts	Aboud et al. (2024)
Universities		
University 1	Draw up an Action Plan consistent with the ESG pillars to achieve significant results in sustainability	UoP (2023)
University 2	Creating a research and development network to address global issues	Oxford (2024)
University 3	Supporting research into crisis solutions through a Strategic Challenge Area	Brunel (2024)
Sponsors		
Sponsor 1	Promoting ESG initiatives to address global issues	European Commission (2021)
Sponsor 2	Fund projects addressed to social and economic inequality	ERC (2024)
Sponsor 3	Implement sustainable actions in collaboration with large companies, SMEs and local startups to boost sustainable competitiveness.	UoB (2024)

A third patent integrates evaluation company data with specific corporate details, such as size and sector, to deliver personalized ESG performance assessments.

UK companies also play a significant role in the MSCI Europe ESG Leaders index, which comprises large and mid-cap companies from 15 countries (14 from the EU and the UK). In this index, UK companies account for 21.54% of the total (MSCI 2024). Notably, in the healthcare sector, AstraZeneca aligns with EU sustainability requirements by adopting GRI guidelines (AstraZeneca 2024). Other companies, such as HSBC and Unilever, follow TCFD and IFRS frameworks, ensuring transparency and alignment with global expectations (HSBC 2024; Unilever 2024).

The UK ranks second globally in the number of startups, with London recognized as the third-largest startup hub worldwide (StartupBlink 2024). The country excels in biotechnology, showcasing a robust scientific base and skilled human capital, with many innovations originating from research institutions (van Wilgenburg et al. 2019).

In academia, leading British universities have made significant strides toward sustainability, engaging their communities through initiatives such as selective waste collection, the use of biodegradable materials in canteens, resource consumption reductions on campuses, the adoption of electric vehicles, and the exclusive use of renewable energy (Brunel 2024; Oxford 2024; UoP 2023). Research and teaching efforts have also focused on ESG and sustainability, including innovations such as the development of enzymes for rapid plastic degradation and carbon emission reduction technologies (UoP 2020). Furthermore, the European Research Council (ERC) annually monitors progress on funded projects, many of which address environmental and social issues such as social inequality,

immigration, food security, and climate change. These projects also explore accessibility in public and digital spaces, leveraging advanced technologies like Artificial Intelligence (ERC 2024).

This synergy of government, industry, and academia reflects the TH dynamic, observed in all three countries analyzed.

5 | Framework With Recommendations for Promoting SD Through ESG

In this section, the authors propose a framework with 24 recommendations designed for public policymakers, companies, and academia to promote SD through the integration of ESG principles. The framework is based on the ESG TSS developed by the authors, which identified and analyzed the most relevant ESG initiatives within the TH spheres of the three countries studied. Therefore, each institution that chooses to follow them must take care to adapt them to its own reality and context. These initiatives, combined with the authors' theoretical knowledge and expertise on the topic, served as benchmarks for the framework's creation, as shown in the board in Figure 5.

The recommendations, flagged with an "R.#" across the text, are organized into three subsections: Section 5.1 (Government), Section 5.2 (Companies), and Section 5.3 (Academia). Their interactions are visually represented in Figure 6.

5.1 | Government

This work recommends legislative and executive actions for governments to enhance ESG adoption, thereby improving national sustainability performance (Ahmadova et al. 2023). For decades,

#	TH	Recommendations
1	Government	Encourage ESG practices for large and/or publicly traded companies
2	Government	Adopting ESG criteria in decisions for public investment funds
3	Government	Monitor and reduce GHG emissions
4	Government	Implement ESG strategies to generate or increase corporate sustainability
5	Government	Promote organizational diversity
6	Government	Use ESG strategies to prevent climate catastrophes
7	Companies	Implement ESG strategies to generate or increase corporate sustainability
8	Companies	Developing digital tools for ESG management
9	Companies	Monitor and reduce GHG emissions
10	Companies	Support small and medium-sized enterprises (SMEs) in adopting ESG practices
11	Companies	Support programs and projects that create positive ESG impacts
12	Companies	Develop digital tools to enhance ESG analysis for investors
13	Companies	Strengthening cybersecurity
14	Academia	Encourage ESG practices for large and/or publicly traded companies
15	Academia	Implement ESG strategies to generate or increase corporate sustainability
16	Academia	Support small and medium-sized enterprises (SMEs) in adopting ESG practices
17	Academia	Develop digital tools for ESG management
18	Academia	Address the challenges faced by companies and investors in aligning ESG information
19	Academia	Creating digital analysis tools tailored for ESG investors
20	Academia	Fostering communication between governments, companies and academia, integrating ESG principles into collaborative initiatives
21	Academia	Create an R&D network for solutions to global issues using ESG strategies
22	Academia	Support programs and projects that create positive ESG impacts
23	Academia	Establish sustainability agendas outlining ESG goals, actions, and timelines
24	Academia	Adopt ESG practices that serve as replicable models for their communities

FIGURE 5 | Framework with recommendations for promoting SD through ESG.

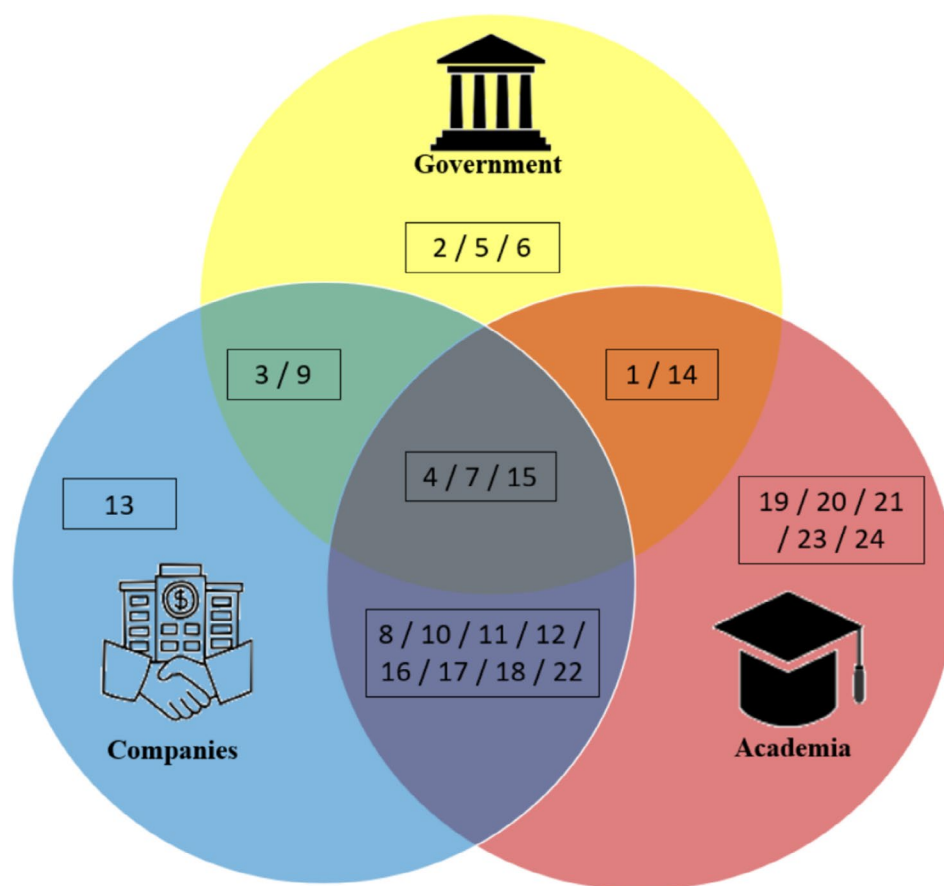


FIGURE 6 | Interaction of recommendations between the TH spheres.

the UN has urged governments to adopt more effective measures for integrating companies into SD initiatives. This is because the engagement of most companies is driven by the demands of the

financial market or compliance, and does not represent legitimate voluntariness in most cases (Ahmadova et al. 2023; Yang et al. 2022; Consolandi et al. 2020). Therefore, it is recommended

that governments create legislation to *encourage ESG practices for large and/or publicly traded companies* (R.#1), broadening the regulatory scope to encompass different corporate types and sizes. Governments can lead by example, *adopting ESG criteria in decisions for public investment funds* (R.#2). This approach minimizes risks for investors, such as retirees and pensioners, as studies consistently show that investments with strong ESG ratings offer superior risk-adjusted returns (Buallay 2019; Fatemi et al. 2018; Pedersen et al. 2021; Zhao et al. 2018). In addition, governments must *monitor and reduce GHG emissions* (R.#3), prioritizing renewable energy sources like solar, wind, and hydroelectric power for public facilities and fleets, thereby supporting environmental preservation (Yang et al. 2022).

Governments are recommended to *implement ESG strategies to generate or increase corporate sustainability* (R.#4) through funding for green innovation, capacity-building programs for services, modernization of agribusiness, and the creation of accessible digital platforms with ESG guidelines. Such governance measures support companies in the sustainable transition, promoting positive environmental and social impacts.

Governments are encouraged to *promote organizational diversity* (R.#5) by implementing regulations that enhance workforce inclusion, focusing on gender equality, disabilities, ethnic representation, age diversity, and gender identity. Research shows that diversity in senior management fosters broader inclusivity across organizations (Adeneye et al. 2024; Ahmad et al. 2024; Albitar et al. 2023; Eliwa et al. 2023).

Finally, governments can *use ESG strategies to prevent climate catastrophes* (R.#6) by enhancing risk identification, mitigation, damage control, and financial planning, ultimately strengthening public administration.

5.2 | Companies

ESG refers to a set of strategies, policies, and practices aimed at encouraging companies to address sustainability issues. Discussing this topic requires an analysis of corporate actions within the broader framework of SD. Over time, ESG has emerged as a key mechanism for guiding companies toward sustainability by emphasizing their responsibility for the environmental and social impacts of their activities (Fu 2023; Kuzey et al. 2023). However, despite the growing adherence of companies to this more responsible governance, the impacts of economic activity on environmental degradation and social inequality, which trigger countless other problems, remain far from acceptable levels (Yang et al. 2022). In this context, it is essential for more companies to commit to the SD. Then, incorporating ESG into organizations is a major step toward achieving sustainability and improving the impacts of their activities (Fatemi et al. 2018; Singh and Kumar 2024). Thus, the recommendations presented in this work for the business sphere offer a robust set of actions that managers can use as benchmarking tools.

To achieve these goals, companies must *implement ESG strategies to generate or increase corporate sustainability* (R.#7). In this effort, emerging technologies such as Artificial Intelligence and

the IoT play a vital role, enabling businesses to find innovative ways to reduce resource consumption and improve operational efficiency. This requires *developing digital tools for ESG management* (R.#8), such as centralized platforms compiling all relevant ESG evaluation metrics, to facilitate transparent monitoring and communication of ethical policies, diversity initiatives, and anti-corruption measures. While real-time monitoring tools for production, consumption, and stock management require significant initial investment, they deliver substantial advancements in efficiency and transparency, providing valuable data for decision-making.

A key aspect of ESG adoption involves *monitoring and reducing greenhouse gas (GHG) emissions* (R.#9), using clean and renewable energy sources in their facilities and fleets. The organizations analyzed in this work reported notable reductions in carbon emissions under Scopes 1 and 2 of the GHG Protocol, which address direct and indirect emissions related to energy and water consumption, such as heating and cooling systems. These reductions were achieved through upgrading infrastructure, transitioning to renewable energy sources, applying disruptive technologies to measure, improve energy efficiency, and optimizing resource consumption in operational processes. In doing so, the organizations demonstrate tangible progress toward the environmental goals of ESG initiatives, particularly in mitigating climate change impacts and promoting sustainable operations. These efforts yield immediate environmental benefits and contribute to financial returns over the medium and long term.

To further amplify sustainability outcomes, leading companies in supply chains should actively *support small and medium-sized enterprises (SMEs) in adopting ESG practices* (R.#10). This includes committing to fair prices, providing guidance and resources to facilitate the transition to sustainable practices, thereby reducing Scope 3 emissions under the GHG Protocol, which encompasses the broader supply chain.

In addition to internal efforts, companies are encouraged to *support programs and projects that create positive ESG impacts* (R.#11) at the regional and national levels. Examples include reforestation initiatives, restoration of water sources, and training for underserved communities. A noteworthy case is AstraZeneca's Healthy Heart Africa program, which aims to prevent and manage hypertension in collaboration with African governments, thereby strengthening the sustainability of local healthcare systems (AstraZeneca 2024). These transformative initiatives address critical social issues in SD, such as health, well-being, economic growth, and professional training, particularly benefiting marginalized communities.

It is also recommended that the business sphere *develop digital tools to enhance ESG analysis for investors* (R.#12), enabling them to customize and monitor portfolios and compare assets for more informed decision-making. Additionally, *strengthening cybersecurity* (R.#13) is essential to safeguard corporate governance and to support the previous recommendations of digital tools development for companies and investors, as suggested in numbers 8 (R.#8) and 12 (R.#12). Thus, it involves protecting strategic business data and sensitive information about

employees, suppliers, and customers, which is vital for maintaining trust and transparency in the ESG context.

5.3 | Academia

The academic sphere plays an important role, both internally, by acting as a transformative agent within its institutions, engaging with sustainable initiatives and shaping the human capital developed through higher education, and externally, by fostering research that supports the business and government spheres in their growth and sustainability objectives (Costa et al. 2024; Rocha et al. 2024; Siao et al. 2022). To provide actionable insights, the authors divided academic benchmarking into two key strands: one focused on developing CS and the other on universities and research funders, offering practical suggestions for institutional sustainability and the projects they support.

The analysis of key articles and authors highlights that countries where ESG declarations are mandatory for certain companies, such as the UK and the EU, tend to achieve better SD outcomes. Hence, the authors recommend that governments *encourage ESG practices for large and publicly traded companies* (R.#14), implementing legal mechanisms to promote corporate commitment to SD. Therefore, it is suggested to *implement ESG strategies to generate or increase corporate sustainability* (R.#15). While financial incentives remain the primary driver for corporate directors to adopt ESG (van Bommel et al. 2023), these practices improve sustainability by strengthening governance, which positively influences other dimensions. Companies that have already implemented ESG strategies are encouraged to *support small and medium-sized enterprises (SMEs) in adopting ESG practices* (R.#16). This initiative offers multiple benefits: it strengthens administrative structures, fosters innovation and sustainability, and improves ESG performance scores for large corporations, which in turn enhances their rankings (Albitar et al. 2023; Hassan et al. 2023).

To support efficient and sustainable corporate operations, it is recommended that they invest in research to *develop digital tools for ESG management* (R.#17). These tools should incorporate both internal and external factors that directly affect ESG ratings and market value. By providing a comprehensive overview of relevant ESG metrics, such tools can guide corporate decision-making and align organizational strategies with sustainability goals. Building on this foundation, developers of ESG evaluation criteria in financial markets must *address the challenges faced by companies and investors in aligning ESG information* (R.#18). This effort will help avoid investments that fail to meet investors' return expectations while maintaining alignment with sustainability goals.

On another front, universities and research organizations are indispensable in the journey toward SD. As hubs of innovation, technology, and human resource development, they are uniquely positioned to create solutions for governments and businesses. Academia can significantly advance ESG by *creating digital analysis tools tailored for ESG investors* (R.#19). Such tools should provide a clear, objective view of portfolio companies' ESG performance, including historical data and comparability

metrics. By *fostering communication between governments, companies and academia, integrating ESG principles into collaborative initiatives* (R.#20), universities can align themselves with a country's key developmental priorities. Examples of successful integration include forums and joint action plans in China, where academia has bridged corporate needs and governmental demands to address local challenges through innovative solutions. Similarly, knowledge development institutions can *create an R&D network for solutions to global issues using ESG strategies* (R.#21). As seen in initiatives by Oxford and Brunel universities in the UK and the National Natural Science Foundation of China, global research networks for ESG-driven solutions have emerged. These efforts focus on mitigating climate-related disasters and addressing their consequences through ESG-aligned strategies for resource planning and distribution.

To maximize their impact, it is therefore suggested that universities and research funding organizations *support programs and projects that create positive ESG impacts* (R.#22). This includes incorporating ESG pillars into funding criteria to promote projects that emphasize environmental preservation, social development, and governance principles such as transparency, anti-discrimination, and anti-corruption. These institutions are encouraged to *establish sustainability agendas outlining ESG goals, actions, and timelines* (R.#23) to guide their activities and support initiatives.

Finally, as agents of social transformation, universities should *adopt ESG practices that serve as replicable models for their communities* (R.#24). Examples include implementing recycling and waste separation programs, transitioning to clean and renewable energy sources, prioritizing regional suppliers and producers, and partnering with companies to develop sustainable solutions. These efforts enhance institutional sustainability and inspire broader societal change.

6 | Conclusions

Historically, the development of nations was viewed as primarily the responsibility of governments, especially in economic and social domains, with limited expectations for collaboration from other societal spheres. However, as discussed in this study, achieving meaningful and lasting results in SD requires coordinated efforts among governments, companies, and academia to promote economic growth, social equity, and environmental preservation. The introduction of regulatory ESG legislation represents an essential initial step in fostering corporate responsibility, supporting businesses in their transition to sustainable models, and strengthening the financial system. This regulatory push has catalyzed significant transformations in publicly traded companies, shifting traditional practices toward sustainability. Similarly, academia has played a critical role by driving innovation, developing technologies that enhance corporate ESG performance, and contributing to operational efficiency.

Although ESG originated within the business sphere, this study underscores its broader applicability, advocating its integration into the agendas of governments and academic institutions to maximize its impact on SD. In this way, the study responds to the research question by demonstrating that a structured synthesis

of international ESG practices can be translated into actionable recommendations grounded in the TH perspective, illustrating how governments, companies, and academia can operationalize ESG to advance SD. Also, in addressing the research question, this work identified key areas of interaction between the spheres of TH, including cooperation, increased dialogue among stakeholders, and the joint development of solutions to ESG challenges. Based on these insights, a comprehensive framework was proposed, offering targeted recommendations for advancing SD through ESG strategies and initiatives, thereby achieving the study's objectives.

The theoretical analysis of scientific production on ESG and its relationship with SD, combined with benchmarking of initiatives by leading countries and the experience of the authors, was essential in identifying the intersections between the spheres of TH and structuring the framework with recommendations for advancing SD through ESG.

The theoretical contributions of this work lie in consolidating and adapting ESG knowledge to contemporary challenges, clarifying its role in advancing SD. This conceptual synthesis contributes to the theoretical development of ESG by integrating well-established models into a coherent structure that explains how sustainability outcomes can be achieved through the articulation of different spheres and actors. The study highlights the importance of expanding ESG initiatives beyond the business sector, showcasing their benefits for governments, educational institutions, and development organizations.

From a practical standpoint, its contributions provide public policymakers with guidance on institutionalizing ESG practices in legislation and fostering collective engagement. For entrepreneurs, it presents opportunities for investment in technology and innovation, demonstrating how these efforts can drive both corporate and regional growth. Similarly, the study offers insights for managers of higher education institutions and research funding organizations, emphasizing how universities' active participation in ESG dialogues can enhance regional SD and train professionals more attuned to sustainability across diverse fields.

Furthermore, the proposed framework can help achieve 12 of the 17 SDGs, offering specific recommendations tailored to governments (SDGs 3, 5, 7, 8, 11, 13, 16, and 17), companies (SDGs 5, 7, 8, 9, 10, 12, and 17), and academia (SDGs 3, 4, 7, 8, 10, 11, 13, and 17).

For future research, we recommend advancing knowledge about the engagement of publicly traded companies in ESG practices, assessing whether these initiatives have been sufficient to contribute to SD in developing or underdeveloped countries. Additional studies could examine the evolution and impacts of ESG in medium-sized private companies and analyze ESG initiatives within local and regional governments. Further investigation might include sector-specific assessments of ESG and SD on a global scale; the interplay between ESG and higher education; and the barriers and incentives to ESG adoption in developing nations, such as green financing mechanisms for technological innovation. Future research could test the proposed framework in different institutional and regional contexts, adapting the

recommendations to local specificities and assessing their practical effectiveness.

Future research could build on the present study by explicitly engaging with the epistemological and ontological foundations of ESG and sustainability science. While our work adopts a technical and organizational perspective, oriented toward practical recommendations for governments, companies, and academia, future investigations may further advance the conceptual development of the field by integrating philosophical discussions from systems theory, institutional theory, and sustainability science. Such contributions would complement the applied orientation of our framework and help strengthen the theoretical evolution of ESG in both academic and practical domains. Future research could also adopt a continental perspective of ESG TSS to benchmark practices and provide comparability with this study's findings. Finally, the development of region-specific ESG indicators represents a promising area for advancing knowledge and practical application in this field.

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Ethics Statement

The authors have nothing to report.

Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- About, A., A. Saleh, and Y. Eliwa. 2024. "Does Mandating ESG Reporting Reduce ESG Decoupling? Evidence From the European Union's Directive 2014/95." *Business Strategy and the Environment* 33, no. 2: 1305–1320. <https://doi.org/10.1002/bse.3543>.
- Adeneye, Y. B., S. Fasihi, I. Kammoun, and K. Albitar. 2024. "Does Earnings Management Constrain ESG Performance? The Role of Corporate Governance." *International Journal of Disclosure and Governance* 21, no. 1: 69–92. <https://doi.org/10.1057/s41310-023-00181-9>.
- Ahmad, H., M. Yaqub, and S. H. Lee. 2024. "Environmental-, Social-, and Governance-Related Factors for Business Investment and Sustainability: A Scientometric Review of Global Trends." *Environment, Development and Sustainability* 26, no. 2: 2965–2987. <https://doi.org/10.1007/s10668-023-02921-x>.
- Ahmadvova, G., M. Bueno García, B. Delgado-Márquez, and L. Pedauga. 2023. "Firm- and Country-Specific Advantages: Towards a Better Understanding of Mnes' Environmental Performance in the International Arena." *Organization and Environment* 36, no. 3: 468–497. <https://doi.org/10.1177/10860266221129699>.
- Ahmed, Z., M. M. Asghar, M. N. Malik, and K. Nawaz. 2020. "Moving Towards a Sustainable Environment: The Dynamic Linkage Between Natural Resources, Human Capital, Urbanization, Economic Growth, and Ecological Footprint in China." *Resources Policy* 67: 101677. <https://doi.org/10.1016/j.resourpol.2020.101677>.

- Albitar, K., T. Abdoush, and K. Hussainey. 2023. "Do Corporate Governance Mechanisms and ESG Disclosure Drive CSR Narrative Tones?" *International Journal of Finance and Economics* 28, no. 4: 3876–3890. <https://doi.org/10.1002/ijfe.2625>.
- Albitar, K., K. Hussainey, N. Kolade, and A. M. Gerged. 2020. "ESG Disclosure and Firm Performance Before and After IR: The Moderating Role of Governance Mechanisms." *International Journal of Accounting and Information Management* 28, no. 3: 429–444. <https://doi.org/10.1108/IJAIM-09-2019-0108>.
- Alibaba. 2024. ESG Report Alibaba 2024. <https://www.alibabagroup.com/en-US/document-1752073403914780672>.
- Alphabet. 2024. Alphabet Environmental Report 2024.pdf. <http://blog.google/outreach-initiatives/sustainability/2024-environmental-report/>.
- Amir, A. Z., and G. Serafeim. 2018. "Why and How Investors Use ESG Information: Evidence From a Global Survey." *Financial Analysts Journal* 74, no. 3: 87–103. <https://doi.org/10.2469/faj.v74.n3.2>.
- AstraZeneca. 2024. Sustainability Report. <https://www.astrazeneca.com/content/dam/az/Sustainability/2024/pdf/Sustainability-Report-2023.pdf>.
- Azmi, W., M. K. Hassan, R. Houston, and M. S. Karim. 2021. "ESG Activities and Banking Performance: International Evidence From Emerging Economies." *Journal of International Financial Markets Institutions and Money* 70: 101277. <https://doi.org/10.1016/j.intfin.2020.101277>.
- BeZero. 2024. Be Zero Carbon.pdf. <https://bezerocarbon.com/about/company>.
- Boudawara, Y., K. Toumi, A. Wannes, and K. Hussainey. 2023. "Shari'ah Governance Quality and Environmental, Social and Governance Performance in Islamic Banks. A Cross-Country Evidence." *Journal of Applied Accounting Research* 24, no. 5: 1004–1026. <https://doi.org/10.1108/JAAR-08-2022-0208>.
- Brunel. 2024. "People-Policies-Plans." <https://www.brunel.ac.uk/about/environment-and-sustainability/home>.
- Buallay, A. 2019. "Is Sustainability Reporting (ESG) Associated With Performance? Evidence From the European Banking Sector." *Management of Environmental Quality: An International Journal* 30, no. 1: 98–115. <https://doi.org/10.1108/MEQ-12-2017-0149>.
- Cai, Y., and H. Etzkowitz. 2020. "Theorizing the Triple Helix Model: Past, Present, and Future." *Triple Helix* 7, no. 2–3: 189–226. <https://doi.org/10.1163/21971927-bja10003>.
- Cai, Y., and A. Lattu. 2022. "Triple Helix or Quadruple Helix: Which Model of Innovation to Choose for Empirical Studies?" *Minerva* 60, no. 2: 257–280. <https://doi.org/10.1007/s11024-021-09453-6>.
- CCB. 2024. Sustainable Finance Report 2024. <https://www.ccb.com/eng/esg/report/index.shtml>.
- Chen, L., M. U. Khurram, Y. Gao, M. Z. Abedin, and B. Lucey. 2023. "ESG Disclosure and Technological Innovation Capabilities of the Chinese Listed Companies." *Research in International Business and Finance* 65: 101974. <https://doi.org/10.1016/j.ribaf.2023.101974>.
- Chen, L., C. Mao, and Y. Gao. 2023. "Executive Compensation Stickiness and ESG Performance: The Role of Digital Transformation." *Frontiers in Environmental Science* 11: 1–11. <https://doi.org/10.3389/fenvs.2023.1166080>.
- Chen, Z., and G. Xie. 2022. "ESG Disclosure and Financial Performance: Moderating Role of ESG Investors." *International Review of Financial Analysis* 83: 102291. <https://doi.org/10.1016/j.irfa.2022.102291>.
- CNPC. 2023. CNPC 2023.pdf. https://mp.weixin.qq.com/s/?__biz=Mzg5NjUzMjM1OA==&mid=2247491911&idx=1&sn=fac3988e9dfb7093acd07d0b12db866e&chksm=c07d0baef70a82b8786ea606bfcfd0f54db3f9c2380189c9e48802948caf52b1a3fa66ddb619&scene=27.
- Consolandi, C., H. Phadke, J. Hawley, and R. G. Eccles. 2020. "Material ESG Outcomes and SDG Externalities: Evaluating the Health Care Sector's Contribution to the SDGs." *Organization and Environment* 33, no. 4: 511–533. <https://doi.org/10.1177/1086026619899795>.
- Cordazzo, M., L. Bini, and G. Marzo. 2020. "Does the EU Directive on Non-Financial Information Influence the Value Relevance of ESG Disclosure? Italian Evidence." *Business Strategy and the Environment* 29, no. 8: 3470–3483. <https://doi.org/10.1002/bse.2589>.
- Costa, A. C. F., A. M. Brito Silva, M. Espuny, A. B. T. Rocha, and O. J. de Oliveira. 2024. "Toward Quality Education: Contributions of EdTech to the Achievement of the Fourth United Nations Sustainable Development Goal." *Sustainable Development* 32, no. 3: 1634–1651. <https://doi.org/10.1002/sd.2742>.
- Costa, A. C. F., V. H. D. M. Santos, and O. J. de Oliveira. 2022. "Towards the Revolution and Democratization of Education: A Framework to Overcome Challenges and Explore Opportunities Through Industry 4.0." *Informatics in Education* 21, no. 1: 1–32. <https://doi.org/10.15388/infedu.2022.01>.
- Crace, L., and J. Gehman. 2023. "What Really Explains ESG Performance? Disentangling the Asymmetrical Drivers of the Triple Bottom Line." *Organization and Environment* 36, no. 1: 150–178. <https://doi.org/10.1177/10860266221079408>.
- Cronin, M. A., and E. George. 2023. "The Why and How of the Integrative Review." *Organizational Research Methods* 26, no. 1: 168–192. <https://doi.org/10.1177/1094428120935507>.
- CUEB. 2023. "China_CUEB_04.pdf." <https://www.cueb.edu.cn/>.
- CUEB. 2024. China_CUEB_04.pdf. <https://www.cueb.edu.cn/>.
- de Oliveira, O. J., A. B. T. da Rocha, A. C. F. Costa, and M. Espuny. 2024. *Technical-Scientific Scenario Based on the Triple Helix: Innovative Approach Beyond Bibliometrics*. IntechOpen. <https://doi.org/10.5772/intechopen.1007689>.
- DHS. 2024. US Department of Homeland and Security. <https://www.dhs.gov/about-dhs>.
- Dimensional. 2024. Dimensional Energy.pdf. <https://www.dimensionalenergy.com/>.
- do Prado, G. F., C. M. Piekarski, L. M. da Luz, J. T. de Souza, R. Salvador, and A. C. de Francisco. 2020. "Sustainable Development and Economic Performance: Gaps and Trends for Future Research." *Sustainable Development* 28, no. 1: 368–384. <https://doi.org/10.1002/sd.1982>.
- Drempetic, S., C. Klein, and B. Zwergel. 2020. "The Influence of Firm Size on the ESG Score: Corporate Sustainability Ratings Under Review." *Journal of Business Ethics* 167, no. 2: 333–360. <https://doi.org/10.1007/s10551-019-04164-1>.
- Eccles, R. G., L. E. Lee, and J. C. Strohle. 2020. "The Social Origins of ESG: An Analysis of Innovest and KLD." *Organization and Environment* 33, no. 4: 575–596. <https://doi.org/10.1177/1086026619888994>.
- Eliwa, Y., A. Aboud, and A. Saleh. 2023. "Board Gender Diversity and ESG Decoupling: Does Religiosity Matter?" *Business Strategy and the Environment* 32, no. 7: 4046–4067. <https://doi.org/10.1002/bse.3353>.
- Engler, H. 2024. *Anti-ESG Legislation Seen Facing Uphill Struggle to Become Law*.pdf. Thomson Reuters. <https://www.thomsonreuters.com/en-us/posts/esg/anti-esg-legislation/>.
- Entitle. 2024. Entitle.pdf. <https://www.entitle.io/>.
- ERC. 2024. "Upcoming Report Assesses the Impact of the ERC's First Years of Research.pdf." <https://erc.europa.eu/news-events/news/upcoming-report-assesses-impact-ercs-first-years-research>.
- ETSU. 2020. "ETSU Sustainability Department—Initiatives." <https://www.etsu.edu/sustainability/what-we-do/initiatives.php>.

- ETSU. 2024. ETSU Sustainability Department - Initiatives. <https://www.etsu.edu/sustainability/what-we-do/initiatives.php>.
- European Commission. 2021. "Delivering the European Green Deal." https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en.
- European Commission. 2024. Delivering the European Green Deal. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en.
- Fatemi, A., M. Glaum, and S. Kaiser. 2018. "ESG Performance and Firm Value: The Moderating Role of Disclosure." *Global Finance Journal* 38: 45–64. <https://doi.org/10.1016/j.gfj.2017.03.001>.
- Folqué, M., E. Escrig-Olmedo, and T. Corzo Santamaría. 2021. "Sustainable Development and Financial System: Integrating ESG Risks Through Sustainable Investment Strategies in a Climate Change Context." *Sustainable Development* 29, no. 5: 876–890. <https://doi.org/10.1002/sd.2181>.
- Fordham. 2022. "ESG Initiatives—Fordham University." <https://www.fordham.edu/gabelli-school-of-business/academic-programs-and-admissions/executive-education/open-enrollment/finance-and-accounting-programs/esg-courses/>.
- Fordham University. 2024. ESG Initiatives - Fordham University. <https://www.fordham.edu/gabelli-school-of-business/academic-programs-and-admissions/executive-education/open-enrollment/finance-and-accounting-programs/esg-courses/>.
- Friedrich, K. 2023. "A Systematic Literature Review Concerning the Different Interpretations of the Role of Sustainability in Project Management." *Management Review Quarterly* 73, no. 1: 31–60. <https://doi.org/10.1007/s11301-021-00230-z>.
- Fu, L. 2023. "Why Bad News Can be Good News: The Signaling Feedback Effect of Negative Media Coverage of Corporate Irresponsibility." *Organization and Environment* 36, no. 1: 98–125. <https://doi.org/10.1177/10860266221108704>.
- García-Sánchez, I. M., C. Aibar-Guzmán, M. Núñez-Torrado, and B. Aibar-Guzmán. 2022. "Are Institutional Investors 'in Love' With the Sustainable Development Goals? Understanding the Idyll in the Case of Governments and Pension Funds." *Sustainable Development* 30, no. 5: 1099–1116. <https://doi.org/10.1002/sd.2305>.
- Gates. 2024. "Bill and Melinda Gates Foundation." <https://www.gatesfoundation.org/>.
- Gillan, S. L., A. Koch, and L. T. Starks. 2021. "Firms and Social Responsibility: A Review of ESG and CSR Research in Corporate Finance." *Journal of Corporate Finance* 66: 101889. <https://doi.org/10.1016/j.jcorpfin.2021.101889>.
- Giupponi, É. C. B., C. F. Poltronieri, Y. S. M. Xavier, and O. J. Oliveira. 2025. "What ESG Has Not (Yet) Delivered: Proposition of a Framework to Overcome Its Hurdles." *Sustainability (Switzerland)* 17: 1–20. <https://doi.org/10.3390/su17188257>.
- GOV.UK. 2024. Defence Infrastructure Organisation Estate and Sustainable Development. <https://www.gov.uk/guidance/defence-infrastructure-organisation-estate-and-sustainable-development>.
- GPMX. 2024. Shanghai Action Plan for the Promotion of Industrial Services Industry Upgrading and Industry Capacity Building. <https://shanghai.gov.cn/gwk/search/content/f18d0513b8eb424b969fa49d9022902e>.
- Gregory, R. P. 2022. "ESG Scores and the Response of the S&P 1500 to Monetary and Fiscal Policy During the Covid-19 Pandemic." *International Review of Economics and Finance* 78: 446–456. <https://doi.org/10.1016/j.iref.2021.12.013>.
- Guerrini, F. 2015. Guerrini, 2015_StartupBlink Wants to Become the One Stop Shop for Startups. pdf. Forbes. <https://www.forbes.com/sites/federicoguerrini/2015/01/20/one-platform-to-map-them-all-startupblink-wants-to-become-the-one-stop-shop-for-the-global-startup-ecosystem/>.
- Hassan, M. K., L. Chiaramonte, A. Dreassi, A. Paltrinieri, and S. Piserà. 2023. "Equity Costs and Risks in Emerging Markets: Are ESG and Sharia Principles Complementary?" *Pacific-Basin Finance Journal* 77: 101904. <https://doi.org/10.1016/j.pacfin.2022.101904>.
- He, F., C. Ding, W. Yue, and G. Liu. 2023. "ESG Performance and Corporate Risk-Taking: Evidence From China." *International Review of Financial Analysis* 87: 102550. <https://doi.org/10.1016/j.irfa.2023.102550>.
- He, F., H. Du, and B. Yu. 2022. "Corporate ESG Performance and Manager Misconduct: Evidence From China." *International Review of Financial Analysis* 82: 102201. <https://doi.org/10.1016/j.irfa.2022.102201>.
- He, F., X. Guo, and P. Yue. 2024. "Media Coverage and Corporate ESG Performance: Evidence From China." *International Review of Financial Analysis* 91: 103003. <https://doi.org/10.1016/j.irfa.2023.103003>.
- Horizon. 2024. Horizon Robotics.pdf. <https://en.horizon.auto/company-profile/>.
- Horne, J., M. Recker, I. Michelfelder, J. Jay, and J. Kratzer. 2020. "Exploring Entrepreneurship Related to the Sustainable Development Goals - Mapping New Venture Activities with Semi-Automated Content Analysis." *Journal of Cleaner Production* 242: 118052. <https://doi.org/10.1016/j.jclepro.2019.118052>.
- HSBC. 2024. Annual Report and Accounts 2023. <https://www.hsbc.com/news-and-views/news/media-releases/2024/hsbc-holdings-plc-annual-results-2023>.
- Huang, L. 2024. "Green Bonds and ESG Investments: Catalysts for Sustainable Finance and Green Economic Growth in Resource-Abundant Economies." *Resources Policy* 91: 104806. <https://doi.org/10.1016/j.resourpol.2024.104806>.
- Jyoti, G., and A. Khanna. 2021. "Does Sustainability Performance Impact Financial Performance? Evidence From Indian Service Sector Firms." *Sustainable Development* 29, no. 6: 1086–1095. <https://doi.org/10.1002/sd.2204>.
- Khan, M. A. 2022. "ESG Disclosure and Firm Performance: A Bibliometric and Meta Analysis." *Research in International Business and Finance* 61: 101668. <https://doi.org/10.1016/j.ribaf.2022.101668>.
- Khan, M. A., A. Khan, M. K. Hassan, and M. P. Maraghini. 2024. "Market Response to Environmental Social and Governance Performance: A Global Analysis." *Research in International Business and Finance* 67: 102131. <https://doi.org/10.1016/j.ribaf.2023.102131>.
- Khan, Z., M. Hussain, M. Shahbaz, S. Yang, and Z. Jiao. 2020. "Natural Resource Abundance, Technological Innovation, and Human Capital Nexus With Financial Development: A Case Study of China." *Resources Policy* 65: 101585. <https://doi.org/10.1016/j.resourpol.2020.101585>.
- Kiva. 2024. Kiva.pdf. <https://www.kiva.org/about>.
- Kolsi, M. C., A. Al-Hiyari, and K. Hussainey. 2023. "Does Environmental, Social, and Governance Performance Mitigate Earnings Management Practices? Evidence From US Commercial Banks." *Environmental Science and Pollution Research* 30, no. 8: 20386–20401. <https://doi.org/10.1007/s11356-022-23616-2>.
- Kuzey, C., H. Al-Shaer, A. S. Karaman, and A. Uyar. 2023. "Public Governance, Corporate Governance and Excessive ESG." *Corporate Governance (Bingley)* 23, no. 7: 1748–1777. <https://doi.org/10.1108/CG-01-2023-0028>.
- LENS. 2024. Patent Search Results. Canberra. <https://www.lens.org/lens/search/patent/list?q=ESG>.
- LegiScan. 2023. USA_AL SB151_Alabama_Senate Bill.pdf. <https://legiscan.com/AL/drafts/SB151/2024>.
- LegiScan. 2024. Senate Resolution WA SR8602. <https://legiscan.com/WA/text/SR8602/id/2243689>.
- Li, Y., M. Gong, X. Y. Zhang, and L. Koh. 2018. "The Impact of Environmental, Social, and Governance Disclosure on Firm Value: The

- Role of CEO Power." *British Accounting Review* 50, no. 1: 60–75. <https://doi.org/10.1016/j.bar.2017.09.007>.
- Lu, Y., L. Wang, and Y. Zhang. 2022. "Does Digital Financial Inclusion Matter for Firms' ESG Disclosure? Evidence From China." *Frontiers in Environmental Science* 10: 1029975. <https://doi.org/10.3389/fenvs.2022.1029975>.
- Luque-Vílchez, M., J. A. Gómez-Limón, M. D. Guerrero-Baena, and P. Rodríguez-Gutiérrez. 2023. "Deconstructing Corporate Environmental, Social, and Governance Performance: Heterogeneous Stakeholder Preferences in the Food Industry." *Sustainable Development* 31, no. 3: 1845–1860. <https://doi.org/10.1002/sd.2488>.
- Meicai. 2024. Meicai.pdf. <https://www.meicai.cn/#/company>.
- Microsoft. 2024. How Can We Advance Sustainability? <https://www.microsoft.com/en-us/corporate-responsibility/sustainability/report>.
- Minkinen, M., A. Niukkanen, and M. Mäntymäki. 2022. "What About Investors? ESG Analyses as Tools for Ethics-Based AI Auditing." *AI & Society* 39, no. 1: 329–343. <https://doi.org/10.1007/s00146-022-01415-0>.
- Miralles-Quirós, M. M., J. L. Miralles-Quirós, and J. R. Hernández. 2019. "ESG Performance and Shareholder Value Creation in the Banking Industry: International Differences." *Sustainability* 11, no. 5: 1404. <https://doi.org/10.3390/su11051404>.
- MOE-CN. 2024. Wang Jiayi Attends 2nd Global Forum on the Ethics of AI.pdf. http://en.moe.gov.cn/news/press_releases/202402/t20240212_1114870.html.
- MSCI. 2024. MSCI_ESG_Leaders_Metodologia.pdf. <https://www.msci.com/msci-esg-leaders-indexes>.
- Nirino, N., G. Santoro, N. Miglietta, and R. Quaglia. 2021. "Corporate Controversies and Company's Financial Performance: Exploring the Moderating Role of ESG Practices." *Technological Forecasting and Social Change* 162: 120341. <https://doi.org/10.1016/j.techfore.2020.120341>.
- NOPSS. 2024. National Office for Philosophy and Social Sciences. <http://www.nopss.gov.cn/>.
- Novatus. 2024. Novatus Global.pdf. <https://novatus.global/about-us/>.
- NSFC. 2024. NSFC at a Glance.pdf. https://www.nsf.gov.cn/english/site_1/about/6.html.
- Nunhes, T. V., M. Bernardo, and O. José de Oliveira. 2020. "Rethinking the Way of Doing Business: A Reframe of Management Structures for Developing Corporate Sustainability." *Sustainability (Switzerland)* 12, no. 3: 1–32. <https://doi.org/10.3390/su12031177>.
- Nunhes, T. V., E. V. Garcia, M. Espuny, et al. 2021. "Where to Go With Corporate Sustainability? Opening Paths for Sustainable Businesses Through the Collaboration Between Universities, Governments, and Organizations." *Sustainability (Switzerland)* 13, no. 3: 1–33. <https://doi.org/10.3390/su13031429>.
- NVIDIA. 2024. Sustainability Report Fiscal Year 2024. <https://images.nvidia.com/aem-dam/Solutions/documents/FY2024-NVIDIA-Corporate-Sustainability-Report.pdf>.
- Oxford. 2024. "Our Priorities in Sustainability." <https://sustainability.admin.ox.ac.uk/our-priorities>.
- Passas, I., K. Ragazou, E. Zafeiriou, A. Garefalakis, and C. Zopounidis. 2022. "ESG Controversies: A Quantitative and Qualitative Analysis for the Sociopolitical Determinants in EU Firms." *Sustainability (Basel)* 14, no. 19: 1–17. <https://doi.org/10.3390/su141912879>.
- Peachman, R. R. 2024. "America's Best Startup Employers." *Forbes*. <https://www.forbes.com/lists/americas-best-startup-employers/>.
- Pedersen, L. H., S. Fitzgibbons, and L. Pomorski. 2021. "Responsible Investing: The ESG-Efficient Frontier." *Journal of Financial Economics* 142, no. 2: 572–597. <https://doi.org/10.1016/j.jfineco.2020.11.001>.
- Peng, L. S., and M. Isa. 2020. "Environmental, Social and Governance (ESG) Practices and Performance in Shariah Firms: Agency or Stakeholder Theory?" *Asian Academia of Management Journal of Accounting and Finance* 16, no. 1: 1–34. <https://doi.org/10.21315/aamjaf2020.16.1.1>.
- Penn. 2024. "ESG Initiative_UoP_USA." <https://www.wharton.upenn.edu/the-wharton-way/elevate/esg-pillar/>.
- Rocha, A. B. T., M. Espuny, J. Kandsamy, and O. J. Oliveira. 2024. "Advancing Sustainability in the Steel Industry: The Key Role of the Triple Helix Sectors." *Environmental Science and Pollution Research* 31, no. 31: 43591–43615. <https://doi.org/10.1007/s11356-024-33983-7>.
- Rockefeller. 2024. "Rockefeller Foundation." <https://www.rockefellerfoundation.org/>.
- Ross, A. 2023. *Pressure Grows for Tighter Scrutiny of Funds' Green Claims*. Financial Times. <http://www.ft.com/content/9772ba1f-0a50-4e2b-8e32-5491b69d22a6>.
- Shalhoob, H., and K. Hussainey. 2023. "Environmental, Social and Governance (ESG) Disclosure and the Small and Medium Enterprises (SMEs) Sustainability Performance." *Sustainability (Switzerland)* 15, no. 1: su15010200. <https://doi.org/10.3390/su15010200>.
- Siao, H. J., S. H. Gau, J. H. Kuo, M. G. Li, and C. J. Sun. 2022. "Bibliometric Analysis of Environmental, Social, and Governance Management Research From 2002 to 2021." *Sustainability* 14, no. 23: 16121. <https://doi.org/10.3390/su142316121>.
- Singh, A. K., and V. R. P. Kumar. 2024. "Establishing the Relationship Between the Strategic Factors Influencing Blockchain Technology Deployment for Achieving SDG and ESG Objectives During Infrastructure Development: An ISM-MICMAC Approach." *Smart and Sustainable Built Environment* 13, no. 3: 711–736. <https://doi.org/10.1108/SASBE-12-2023-0405>.
- SISD. 2023. China Business Network ESG Acceleration Camp for Listed Companies. <https://www.yicai.com/news/101863052.html>.
- StartupBlink. 2024. Global Rank Top 10. <https://www.startupblink.com/startups#rankings>.
- SUFE. 2023. "China_SUFE_02.pdf." <https://www.sufe.edu.cn/>.
- SUFE. 2024. China_SUFE_02.pdf. <https://www.sufe.edu.cn/>.
- Sun, Z., X. Sun, W. Wang, and W. Wang. 2025. "Digital Transformation and Greenwashing in Environmental, Social, and Governance Disclosure: Does Investor Attention Matter?" *Business Ethics, the Environment and Responsibility* 34, no. 1: 81–102. <https://doi.org/10.1111/beer.12585>.
- Taliento, M., C. Favino, and A. Netti. 2019. "Impact of Environmental, Social, and Governance Information on Economic Performance: Evidence of a Corporate 'Sustainability Advantage' From Europe." *Sustainability* 11, no. 6: 1738. <https://doi.org/10.3390/su11061738>.
- Tan, Y., and Z. Zhu. 2022. "The Effect of ESG Rating Events on Corporate Green Innovation in China: The Mediating Role of Financial Constraints and Managers' Environmental Awareness." *Technology in Society* 68: 101906. <https://doi.org/10.1016/j.techsoc.2022.101906>.
- Teixeira Dias, F., A. R. de Aguiar Dutra, A. L. Vieira Cubas, M. F. Ferreira Henckmaier, M. Courval, and J. B. S. O. de Andrade Guerra. 2023. "Sustainable Development With Environmental, Social, and Governance: Strategies for Urban Sustainability." *Sustainable Development* 31, no. 1: 528–539. <https://doi.org/10.1002/sd.2407>.
- Tencent. 2024. Social and Governance Report. <https://static.www.tencent.com/uploads/2024/04/08/a041eba55b96c7952e26180a2c7cdd28.pdf>.
- Umar, Z., D. Kenourgios, and S. Papathanasiou. 2020. "The Static and Dynamic Connectedness of Environmental, Social, and Governance Investments: International Evidence." *Economic Modelling* 93: 112–124. <https://doi.org/10.1016/j.econmod.2020.08.007>.
- Unilever. 2024. Unilever Annual Report and Accounts. <https://www.unilever.com/files/92ui5egz/production/b09c3510ee7cec58440d5f044f02bdefe85aa186.pdf>.

- UOB. 2024. University of Birmingham 2030 Strategic Framework.pdf. <https://university-of-birmingham.foleon.com/bham2030/strategic-framework/case-studies#BIFoR>.
- UoP. 2020. "Becoming a Climate-Positive University." <https://www.port.ac.uk/about-us/our-ambition/sustainability>.
- UoP. 2023. "Sustainability at Portsmouth." <https://www.port.ac.uk/about-us/our-ambition/sustainability>.
- US GOV. 2024. THE WHITE HOUSE. Executive order 14030. <https://www.govinfo.gov/content/pkg/FR-2021-05-25/pdf/2021-11168.pdf>.
- van Bommel, K., A. Rasche, and A. Spicer. 2023. "From Values to Value: The Commensuration of Sustainability Reporting and the Crowding out of Morality." *Organization and Environment* 36, no. 1: 179–206. <https://doi.org/10.1177/10860266221086617>.
- van Wilgenburg, B., K. van Wilgenburg, K. Paisner, S. van Deventer, and R. W. Rooswinkel. 2019. "Mapping the European Startup Landscape." *Nature Biotechnology* 37, no. April: 345–349. <https://doi.org/10.1038/s41587-019-0076-4>.
- Vertical. 2024. Vertical Future.pdf. <https://verticalfuture.com/>.
- Wang, L., X. Fan, and H. Zhuang. 2023. "ESG Disclosure Facilitator: How Do the Multiple Large Shareholders Affect Firms' ESG Disclosure? Evidence From China." *Frontiers in Environmental Science* 11: 1063501. <https://doi.org/10.3389/fenvs.2023.1063501>.
- Wang, L., J. Qi, and H. Zhuang. 2023. "Monitoring or Collusion? Multiple Large Shareholders and Corporate ESG Performance: Evidence From China." *Finance Research Letters* 53: 103673. <https://doi.org/10.1016/j.frl.2023.103673>.
- WEF. 2024. *The Future of Growth Report 2023*. World Economic Forum. https://www3.weforum.org/docs/WEF_Future_of_Growth_Report_2024.pdf.
- Xie, J., W. Nozawa, M. Yagi, H. Fujii, and S. Managi. 2019. "Do Environmental, Social, and Governance Activities Improve Corporate Financial Performance?" *Business Strategy and the Environment* 28, no. 2: 286–300. <https://doi.org/10.1002/bse.2224>.
- XJTU. 2024. Xi'an Jiaotong University.pdf. <https://www.xjtu.edu.cn/index.htm>.
- Yang, P., X. Hao, L. Wang, S. Zhang, and L. Yang. 2024. "Moving Toward Sustainable Development: The Influence of Digital Transformation on Corporate ESG Performance." *Kybernetes* 53, no. 2: 669–687. <https://doi.org/10.1108/K-03-2023-0521>.
- Yang, Q., Q. Du, A. Razzaq, and Y. Shang. 2022. "How Volatility in Green Financing, Clean Energy, and Green Economic Practices Derive Sustainable Performance Through ESG Indicators? A Sectoral Study of G7 Countries." *Resources Policy* 75: 102526. <https://doi.org/10.1016/j.resourpol.2021.102526>.
- Yitu. 2024. Yitu Tech.pdf. <https://www.yitutech.com/>.
- Zhao, C., Y. Guo, J. Yuan, et al. 2018. "ESG and Corporate Financial Performance: Empirical Evidence From China's Listed Power Generation Companies." *Sustainability (Basel)* 10, no. 8: 1–18. <https://doi.org/10.3390/su10082607>.
- Zheng, J., M. U. Khurram, and L. Chen. 2022. "Can Green Innovation Affect ESG Ratings and Financial Performance? Evidence From Chinese GEM Listed Companies." *Sustainability (Basel)* 14, no. 14: 1–32. <https://doi.org/10.3390/su14148677>.

Appendix 1

Complete Table 1

Complete Table 1 ESG's Technical–Scientific Scenery in the USA

Topic	ESG initiatives		References
	Technical scenery		
Government			
Laws, regulations, and public policy			
LRPP 1: Executive Order	Implementing high-impact sustainable actions, such as the energy transition to clean energy, a zero-emission fleet, net carbon reductions in all federal government buildings and facilities, increasing energy efficiency, reducing waste, prioritizing sustainability in the procurement of goods and services, supporting a sustainable supply chain, and educating and training the federal workforce.		US Gov. (2024)
LRPP 2: Senate Bill	Regulate laws that include the consideration of ESG factors in investment decisions made by state or local government representatives, or public corporations that manage public funds, to support GHG emission reduction measures.		LegiScan (2023)
LRPP 3: Senate Resolution	Encouraging the participation of the female workforce and their collaboration in technological development and innovation, through the Women in Cloud organization, which offers knowledge and support for women to build sustainable businesses that generate technological advances.		LegiScan (2024)
Enterprises			
Patents			
Patent 1: ESG performance trends Property of: Rockefeller and Co.	Create an ESG performance trend analysis dashboard for investors, based on each company's historical data and mapping its materiality points according to its sector (retail, mining, automotive, textiles, etc.), using one or more rating agency databases.		Lens (2024)
Patent 2: User interface for combining ESG and financial analysis Property of: Morgan Stanley Services Group Inc.	Develop an interactive system for investors to analyze companies' ESG and financial data through a dynamic graphics interface in four modules: screening, rating, climate and sustainability, using one or more rating agency databases.		Lens (2024)
Patent 3: System and method for determining and managing the ESG perception of organizations and industries through the use of surveys and media data Property of: Reprtrak Holdins Inc.	Create systems and methods to determine the perception of public opinion on the stance of organizations (entities and industries) concerning the impacts of their activities on ESG aspects, using opinion polls and media data to generate a score (0–100).		Lens (2024)
ESG reports			
Report 1: Microsoft Corp.	Defining targets to promote sustainability internally, in customer service and globally, divided into four areas: reducing carbon emissions; redistributing water—reducing its use in operational processes and supplying it to communities in need; eliminating waste in inputs, processes and products; and protecting ecosystems. These goals are organized in a sustainability agenda aligned with the United Nations (UN) 2030 Agenda.		Microsoft (2024)
Report 2: NVIDIA Corp.	Using generative AI to optimize resources, increase productivity and generate sustainability through computing, developing technologies that can be applied to various businesses such as industries, retail and agriculture, as well as creating resources for predicting weather patterns and incident alerts that serve governments and NGOs.		Nvidia (2024)
Report 3: Alphabet (Grupo Google)	Using AI technology to drive positive environmental change, such as traffic analysis that considers vehicle characteristics to direct the most efficient route and the tool that helps traffic engineers optimize traffic light timing, both of which generate fuel savings and reduce carbon emissions.		Alphabet (2024)

Topic	ESG initiatives		References
	Technical scenery		
Startups			
Startup 1: Dimensional Energy	Employ innovative technology to convert carbon dioxide captured from the atmosphere or industrial facilities into sustainable products, helping to mitigate climate change. Some products such as aviation fuel are in the testing phase, being developed in partnership, and have already shown a 93% reduction in the carbon footprint at the pilot plant.		Dimensional (2024)
Startup 2: Kiva	Expanding financial access to support communities in need, allowing anyone to offer small loans and choose the business or initiative to benefit. Founded in San Francisco, the startup has expanded to 81 countries, benefiting 2.2 million lenders with a total of 2.06 billion dollars in loans.		Kiva (2024)
Startup 3: Entitle	Automate cloud permissions to optimize security and productivity for companies, avoiding manual management by the IT team or the unrestricted granting of access, which compromises security.		Entitle (2024)
Scientific scenery			
Academia			
Articles			
Article 1: “Firms and social responsibility: A review of ESG and CSR research in corporate finance”	To explore how ESG factors such as gender, age, trust, political donations and CEO remuneration influence market value, considering aspects such as territoriality, sector, management style and type of ownership. The study reviews scientific articles on corporate finance.		Gillan et al. (2021)
Article 2: “Why and how investors use ESG information: Evidence from a global survey”	To identify the motivation and difficulties of investors in a particular financial market, the authors developed a questionnaire on ESG data. Data, based on responses from 652 US CEOs and managers, conclude that the motivation is financial, while the difficulties include the implementation of practices and the comparability of information.		Amir and Serafeim (2018)
Article 3: “ESG performance and firm value: The moderating role of disclosure”	To identify how factors such as the number of shareholders and the presence of a CSR committee affect ESG reporting and governance practices, based on data from 1640 observations of 403 companies listed in the US between 2006 and 2011.		Fatemi et al. (2018)
Articles			
Author 1: Linda-Eling Lee, MSCI Global Chief of ESG Research	Examining MSCI’s ESG metrics, developed by the KLD and Innovest agencies, to improve corporate policies. The study explores the evolution of these agencies’ metrics and highlights the importance of contextualizing each indicator for an accurate functional assessment.		Eccles et al. (2020)
Author 2: Richard P. Gregory, Finance Professor at East Tennessee State University.	To analyze the individual impact of ESG pillars on corporate results during crises, using data on performance, leverage, liquidity, ROE, size, tangibility and volatility of the 500 largest companies in the SandP 1500 with MSCI ESG rating and separation between financial and nonfinancial sectors by Bloomberg. The conclusion is that the Governance pillar is the most affected in critical times, but when well structured, it provides greater resilience to face crises.		Gregory (2022)
Author 3: M. Kabir Hassan, Professor at New Orleans University	Develop a sustainable product pricing method that allocates appropriate costs to each ESG aspect, promoting sustainability and financial security in the supply chain. The study examined 5038 companies in 73 countries with ESG scores between 2016 and 2021, revealing that the costs passed on to the supply chain often do not support sustainability, especially in the environmental and social aspects.		Khan et al. (2024)
Universities			
University 1: Fordham University	Implement practices to strengthen ESG at the university, including clean energy awareness, psychological support for students (<i>cura personalis</i>), and ESG courses and workshops, to improve university sustainability and replicate these initiatives in the academic community.		Fordham University (2024)
University 2: East Tennessee State University (ETSU)	Disseminate and apply sustainable practices to integrate the university with the local community, promoting local production and trade and improving the quality of life of students. The Sustainability Department has implemented programs to reduce emissions, encourage the use of public transport and cycling, minimize waste and adopt waste composting.		ETSU (2024)

Scientific scenery		
University 3: University of Pennsylvania	Offering courses in Sustainability, Energy and Environmental Management, as well as MBAs in ESG, where students are encouraged to solve real problems in partnership with local companies, promoting the expansion of ESG among small and medium-sized enterprises.	Penn (2024)
Sponsors		
Sponsor 1: Bill and Melinda Gates Foundation, Philanthropic Institution	Use the ESG pillars as a condition for approving projects, THAT is, consider maximizing the positive impacts of their resources in their funding strategies, so that these projects promote sustainable and equitable practices at all stages.	Gates Foundation (2024)
Sponsor 2: Rockefeller Foundation, Philanthropic Institution	To direct its resources to projects that promote human well-being, such as socio-economic development and environmental conservation initiatives committed to ESG principles. By applying diligent governance to ensure transparency, responsibility and effectiveness in management, including accountability practices, impact assessment and collaboration with local and international partners.	Rockefeller Foundation (2024)
Sponsor 3: USA Dept. of Homeland Security, Govern Institution	Integrate ESG principles into the projects and operations it finances to promote activities that are environmentally sustainable, socially responsible and comply with the highest standards of governance.	DHS (2024)

Appendix 2

Complete Table 2

Complete Table 2—ESG's Technical–Scientific Scenery in China

Topic	ESG initiatives	
	Technical scenery	References
Government		
Laws, regulations, and public policy		
LRPP 1: Commercial Companies Act	Enact laws for companies to preserve the interests of stakeholders in their activities, demonstrating a commitment to environmental preservation, worker and social welfare, and transparent governance, through ecological and innovative investments that promote ESG without jeopardizing shareholder investments.	CNPC (2023)
LRPP 2: Shanghai Action Plan for the Promotion of Industrial Services Industry Upgrading and Industry Capacity Building (2024–2027)	Encourage and promote new models of integrated production services, promoting the training and development of service providers for industries, to generate productivity, modernization, improvements in working conditions, and expand employment and income opportunities in the national industry supply chain.	GPMX (2024)
LRPP 3: Research Institute for Sustainable Development in Science and Technology	Structure an ESG Acceleration Field to leverage SD, green innovation, strengthen the construction of the Green Financial System and achieve the SDGs by concentrating ESG laws, regulations, policies and guidelines for all types of companies on one platform.	SISD (2023)
Enterprises		
Patents		
Patent 1: ESG storage style integration method and equipment Property of: Taiwan Trust Commercial Bank Co. Ltd.	Create a management system and method to integrate companies and investors in ESG projects, offering advantageous financial conditions for both sides, such as preferential interest rates to promote sustainable and responsible business practices.	Lens (2024)
Patent 2: ESG data center analysis system and method based on Internet of Things (IoT) technology Property of: Zhejiang City College	Develop an ESG data management and storage system for investors, using IoT to process large volumes of data and enable specific analyses according to the criteria of each investor, allowing for a more efficient and secure assessment of the operation and development of companies and reducing investment risks.	Lens (2024)
Patent 3: Blockchain-based ESG trusted index comprehensive services platform Property of: Jiangsu Rongzer Inf. Tec. Co. Ltd.	Create a Blockchain-based ESG platform with four modules: data acquisition, production analysis, green authentication and project release. The platform collects energy data from companies, analyzes their operational capacity, authenticates green certifications and publishes information to guide banks and investors in sustainable decisions.	Lens (2024)

Topic	ESG initiatives		References
	Technical scenery		
ESG reports			
Report 1: Tencent Holding Limited	Developing programs with a social and environmental impact, such as the AIMIS digital medical imaging platform, which uses AI for rapid screening in imaging exams, helping in the early diagnosis and prevention of cancer in women.		Tencent (2024)
Report 2: China Construction Bank	Implement rural development assistance programs under the “Five Revitalizations” strategy, focusing on industrial, organizational, cultural, ecological and training areas, strengthening agribusiness and promoting rural tourism to alleviate poverty.		CCB (2024)
Report 3: Alibaba Group Holding Limited	Applying generative AI to reduce production costs in small and medium-sized businesses, optimizing operations and creating commercial content (videos and photos) from product data, eliminating advertising and marketing costs.		Alibaba (2024)
Startups			
Startup 1: Horizon Robotics	Developing intelligent driving solutions for human safety, with a focus on driver assistance, autonomous driving, low cost and energy efficiency. The startup supplies ADAS and Automated Driving technologies to automotive companies, such as its partnership with Li Auto for the launch of the L9 Pro model in 2023.		Horizon (2024)
Startup 2: Meicai	Promoting the direct sale of vegetables and fresh produce between producers and restaurants in China via the Internet, eliminating intermediaries to offer lower prices, transparency and fast deliveries.		Meicai (2024)
Startup 3: Yitu	Promoting innovative solutions for smart cities and companies with a view to a safer and healthier world. The team, including founder Zhu Long, carries out research into AI, with academic experience at the Massachusetts Institute of Technology (MIT).		Yitu (2024)
Scientific scenery			
Academia			
Articles			
Article 1: “ESG and corporate financial performance: Empirical evidence from China’s listed power generation companies”	Create an ESG agenda for companies, based on a comparison between their actual performance and the global average for their sector. The study analyzed China’s five largest energy corporations, looking at indicators such as gas emissions, pollution, water use and waste, environmental and workplace accidents, and ESG committee characteristics.		Zhao et al. (2018)
Article 2: The effect of ESG rating events on corporate green innovation in China: The mediating role of financial constraints and managers’ environmental awareness	To identify how ESG practices promote green innovation in companies, the authors investigated nonfinancial companies with class A shares on the China Stock Exchange between 2010 and 2018, analyzing indicators such as company size and age, quantity and quality of investments in technology and innovation, and concluded that companies with better ESG scores invest more in green innovation and that the quality of these technologies is also higher than that of companies with lower or no ESG scores.		Tan and Zhu (2022)
Article 3: ESG disclosure and financial performance: Moderating role of ESG investors	Develop an ESG monitoring dashboard for listed companies, integrating data from agencies such as MSCI and Bloomberg, with indicators for the ecological cycle, biodiversity, product safety, anti-discrimination, ethics and governance. The research examined the relationship between the ESG reports of Chinese companies and their ranking by MSCI and Bloomberg from 2000 to 2020.		Chen and Xie (2022)
Authors			
Author 1: Feng He, Professor at Beijing Capital University of Economics and Business	To analyze the impact of the media on companies’ ESG decisions, based on 22,888 observations of companies listed on the Shanghai and Shenzhen Stock Exchanges between 2010 and 2019. It was concluded that media coverage has a positive effect, strengthening companies’ commitment to ESG pillars and influencing shareholders, employees, suppliers, customers and environmental and public responsibilities.		He et al. (2024)
Author 2: Lifeng Chen	To study how ESG disclosure contributes to companies’ technological innovation capacity (TIC), using the number of patents as an indicator. Data from 7146 patents of listed companies from 2011 to 2019 show that companies with better ESG ratings improve ICT at operational, strategic and financial levels.		Chen, Khurram, et al. (2023), Chen, Mao, and Gao (2023)

Scientific scenery		
Author 3: Liang Wang	Investigate how digital transformation influences ESG performance, looking at green innovation, transparency and governance. Using data from 3131 nonfinancial companies and Peking University's Digital Financial Inclusion Index (2011–2018), the study validates that digital inclusion strengthens ESG disclosure.	Yang et al. (2024)
Universities		
University 1: Capital University of Economics and Business	To create opportunities to increase dialogue between governments, companies and academia for the development of new public policies, corporate initiatives and scientific research on ESG, the first (Chinese) Capital Market Innovation Development Forum was created.	CUEB (2024)
University 2: Xi'an Jiaotong University	Create an Action Plan for ESG development at the university, interweaving ESG principles, the SDGs and national goals for technological, scientific and educational development. This plan aims to transform the country's scientific development by applying pragmatic cooperation in higher education in integration with industry.	XJTU (2024)
University 3: Shanghai University of Finance and Economics	Draw up projects to expand and improve the ESG based on the profile and needs of local companies. To this end, a pilot International Development and ESG Practices program was launched in partnership with major financial institutions, specially designed to cover ESG issues in academic training for senior executives in Chinese companies.	SUFE (2024)
Sponsors		
Sponsor 1: National Natural Science Foundation of China	Promoting international scientific collaboration through a management division that finances research into corporate governance and the <i>Science Fund for Global Challenges and Sustainability</i> . It also has a program called “ <i>Sustainable Development International Cooperation</i> ” (SDIC), which seeks to promote a community with a shared future, focusing on the southern hemisphere.	NSFC (2024)
Sponsor 2: National Office for Philosophy and Social Sciences	Assisting in the selection of projects related to ESG issues, through the management of the “ <i>National Social Science Fund</i> ”.	NOPSS (2024)
Sponsor 3: Ministry of Education of the People's Republic of China	Create specialization and innovation in critical areas such as digital transformation, quantum computing and sustainability through initiatives that encourage these points.	MOE-CN (2024)

Appendix 3

Complete Table 3

Complete Table 3 ESG's Technical–Scientific Scenery in the UK

Topic	ESG initiatives	
	Technical scenery	References
TH sphere—government		
Laws, regulations, and public policy		
LRPP 1: Guidelines for publishing ESG reports	Extend the obligation to disclose ESG information to large companies, including multinationals and national private companies, to increase sustainability levels in all economic sectors.	GOV.UK (2024)
LRPP 2: Green Investment Strategy	Develop ESG-based government strategies to promote sustainability by financing green technologies, clean energy programs and restructuring markets with high environmental standards in agribusiness.	GOV.UK (2024)
LRPP 3: Orientation—Defense Infrastructure Organization and Sustainable Development	Increase climate resilience and plan for long-term solutions by identifying risks of extreme events and implementing conservation actions, community engagement and sustainable water, energy and waste management to maintain the government's operational capacity.	GOV.UK (2024)
TH sphere—enterprises		
Patents		
Patent 1: Device and method for ESG administration based on company management software Property of: I ESG Inc.	Develop administration software to manage ESG aspects in companies, with environmental, social and governance assessment modules that generate diagnoses on materiality and general ESG assessment.	Lens (2024)

Topic	ESG initiatives	
	Technical scenery	References
Patent 2: System and method that classifies companies in ESG terms Property of: The Dun and Breadstreet Corp.	Create a system that uses machine learning, including web scraping and natural language processing, to transform online ESG information into specific scores for each ESG aspect of the company.	Lens (2024)
Patent 3: ESG Performance Trends Property of: Rockefeller and Co LLC.	Developing a program that unifies different ESG metrics, helping investors make decisions by generating an objective score and evaluating ESG performance trends based on historical data.	Lens (2024)
ESG reports		
Report 1: AstraZeneca	Utilizing the product portfolio to promote equitable access to healthcare, including open innovation and intellectual property (IP) sharing such as patent clearance in developing and underdeveloped countries.	AstraZeneca (2024)
Report 2: HSBC Holdings	Encouraging the reduction of carbon emissions by facilitating credit for companies to invest in green technology and innovation, broadening the access of small and medium-sized companies to opportunities related to sustainability.	HSBC (2024)
Report 3: Unilever	Create mechanisms to guide, support and monitor the supply chain to control deforestation, adopt regenerative agricultural practices, reduce water stress and waste, and guarantee decent wages and workers' rights.	Unilever (2024)
Startups		
Startup 1: Be Zero Carbon	Supporting organizations to invest in sustainable environmental markets, offering knowledge and tools for climate decisions. The carbon rating agency has 70% of its staff made up of PhDs, with more than 250 scientific publications and co-founded the Woman in Carbon initiative to increase female participation in the carbon industry.	BeZero (2024)
Startup 2: Novatus Global	Providing support for organizations in terms of regulatory compliance. They work with risk management and operational resilience, acting with 100% success in authorizations for banks, asset managers and crypto-asset companies.	Novatus (2024)
Startup 3: Vertical Future	Providing vertical farming systems, with technologies that cover everything from sowing to harvesting, including adaptive lighting, hydroponic nutrition and complete automation. The start-up collaborates with the World Green Economy Organization (WGEO).	Vertical (2024)
Scientific scenery		
TH sphere—academia		
Articles		
Article 1: “The impact of environmental, social, and governance disclosure on firm value: The role of CEO power”	To analyze the impact of the influence of CEOs on ESG reporting on company value. The authors analyzed financial indicators and other variables such as plant and equipment (PPE), ESG disclosure data and director remuneration data (CEO POWER) from 350 large FTSE companies (2004–2013), and concluded that the greater the CEO's power over ESG decisions, the greater the company's value.	Li et al. (2018)
Article 2: “Responsible investing: The ESG-efficient frontier”	Examine the ideal ESG investments for different investor profiles (carefree, worried and motivated) using the Efficient Frontier Theory, which associates lower risk with higher return and better ESG scores. The analysis used ESG data from MSCI and carbon indices, socially responsible shares and governance attributes.	Pedersen et al. (2021)
Article 3: “Is sustainability reporting (ESG) associated with performance? Evidence from the European banking sector”	To study how microeconomic factors (type of company, size, etc.) and macroeconomic factors (GDP, the country's level of economic and technological development) influence ESG performance and financial results. Analyzing data from 235 European banks (2007–2016), it was found that microeconomic variables affect specific aspects of ESG, while macroeconomic factors impact overall ESG performance and financial results.	Buallay (2019)
Authors		

Scientific scenery		
Author 1: Khaled Hussainey, Professor at Bangor University	To develop guidelines for implementing ESG in Small and Medium-Sized Enterprises (SMEs), based on interviews with 30 companies to assess awareness of sustainability, willingness to disclose ESG, most practiced aspects and disclosure challenges/options. SWOT analysis was used to interpret the results.	Shalhoob and Hussainey (2023)
Author 2: Khaldoun Albitar, Professor at the University of Glasgow	To examine how the narrative of ESG reports affects stakeholders and business results. In FTSE 100 companies, the tone of the reports was compared to governance elements such as board size, gender diversity and the presence of independent directors and audit committees.	Albitar et al. (2023)
Author 3: Ahmed Aboud, Professor at Zayed University	To analyze the impact of mandatory ESG disclosure on the accuracy of the data in comparison with the real impacts. In a sample of 1510 large companies from the EU (where disclosure is mandatory) and the US (where it is voluntary), it was concluded that regulatory pressure reduces distortion in environmental, human rights, social responsibility and anti-corruption impacts.	Aboud et al. (2024)
Universities		
University 1: University of Portsmouth	Draw up an Action Plan that is consistent with the ESG pillars and brings significant results in terms of sustainability. In this way, the UoP has put into practice its goals to become a climate-positive university. Actions include replacing plastics with biodegradable materials, managing recyclables and encouraging sustainable transport for those living near campus.	
University 2: University of Oxford	Creating a research and development network for solutions to global issues such as climate emergencies, food security and the optimization of water and energy resources. Then, the university created a multidisciplinary department called Oxford Networks for the Environment (ONE) where it makes its resources available to develop technologies that contribute to ESG aspects of SD.	Oxford (2024)
University 3: Brunel University London	Supporting research into crisis solutions, the transition to a net-zero emissions economy and the green industrial revolution through a Strategic Challenge Area. This initiative is part of the university's commitment to the UN SDGs, with more than 380 signatories, including professors, students and organizations.	Brunel (2024)
Sponsors		
Sponsor 1: European Commission	Promoting ESG initiatives to support vulnerable people, help small businesses in the ecological transition, achieve carbon neutrality in industries and create jobs in the production of clean technologies, such as the Social Climate Fund, Green Deal Industrial Plan and Net-Zero Industry Act programs.	European Commission (2024)
Sponsor 2: European Research Council	Fund projects that seek to address social and economic inequality, immigration, food shortages, diversity and its impact on health, fertility patterns and climate change. The ERC carries out annual independent evaluations to ensure the robustness and impact of projects, promoting scientific progress and industrial, social and economic benefits.	ERC (2024)
Sponsor 3: University of Birmingham	It implements sustainable actions through the Birmingham Institute of Forest Research (BIFoR) and carries out interdisciplinary research into technologies that change lives, global health, the connection of cultures, planetary prosperity and social justice. Recognized by the Green World Award in 2018, the institute collaborates with large companies, SMEs and local startups to boost sustainable competitiveness.	UoB (2024)