# Reviewing environmental aspects under the scope of ESG

Halkos, George and Aslanidis, Panagiotis-Stavros

Department of Economics, University of Thessaly

February 2024

# Reviewing environmental aspects under the scope of ESG

**George E. Halkos & Panagiotis – Stavros C. Aslanidis**

*Laboratory of Operations Research, Department of Economics, University of Thessaly*

**Abstract**

Globalisation has created a highly interconnection between countries, however this phenomenon has ushered in more abrupt dissemination of crises as well. For this reason, the countries have strengthened their resilience against the novel multi-crisis via the implementation of frameworks, pathways, and strategies. A great paradigm is the environmental, social, and corporate governance (ESG) as a way to absorb the negative environmental externalities. The present study would review the ESG-related key performance indicators (KPIs) as integral part of circular economy (CE). Moreover, it is imperative that focus be given to both similarities and differences between ESG and sustainable development goals (SDGs), as they are milestones for sustainable development and they are highly interlinked with corporate performance.

*Keywords:* *multi-crisis, globalization, KPIs, ecological footprint, carbon footprint, Circular economy, SDGs.*

*Jel Codes:* *G3, M1, M14, Q01*

## 1. Introduction: Globalization and Multi-crisis

The transition from industrial revolution to globalization is followed by environmental pollution and degradation. The acceleration of growth in the Western World has been achieved through the industrial revolution by the adoption of new technologies such as sewing machines, stream, and electricity (Deane, 1979; Wadanambi et al., 2020).

Globalization is like the Pandora's box. Globalization led to the intensification of global value chains with direct repercussions to the natural environment due to negative externalities (Ekonomou and Halkos, 2023; Halkos and Ekonomou, 2024). Arguably, there was a permission for interaction of cities, regions, and countries. In essence, globalization has a dual-faceted nature, on the one hand there is rapid dissemination of information, on the other hand exists the peril of crisis spreading.

The economic history escalated, from the mid-19$^{th}$ century till the advent of 20$^{th}$ century, with great leaps. Nevertheless, the last three decades of the 20$^{th}$ century some environmental challenges have erupted, inter alia oil spills (Jernelöv, 2010), soil pollution (Adnan et al., 2022; Aslanidis and Golia, 2022), resource depletion, biodiversity loss (Dasgupta, 2021; Halkos, 2023), and waste crisis (Halkos and Aslanidis, 2024a; Hossain et al., 2022). The global commodities flows have skyrocketed during the last decade of the 20th century, leading to an era of rapid economic transactions and the so-called 4$^{th}$ industrial revolution with high-tech applications everywhere (Majid et al., 2022).

Multi-crisis is the child of globalization. Multi-crisis refers to the existence of multiple crises at the same time, for instance the war in Ukraine, COVID-19, and climate change (Halkos and Aslanidis, 2023a; Kuzemko et al., 2020; Tooze, 2022). The multi-crisis imposes challenges to citizens and business alike. However, how can the corporate world be more resilient to this multi-crisis? A possible answer to this question might be the promotion of corporate social responsibility (CSR) (Halkos and Nomikos, 2021a, 2021b).

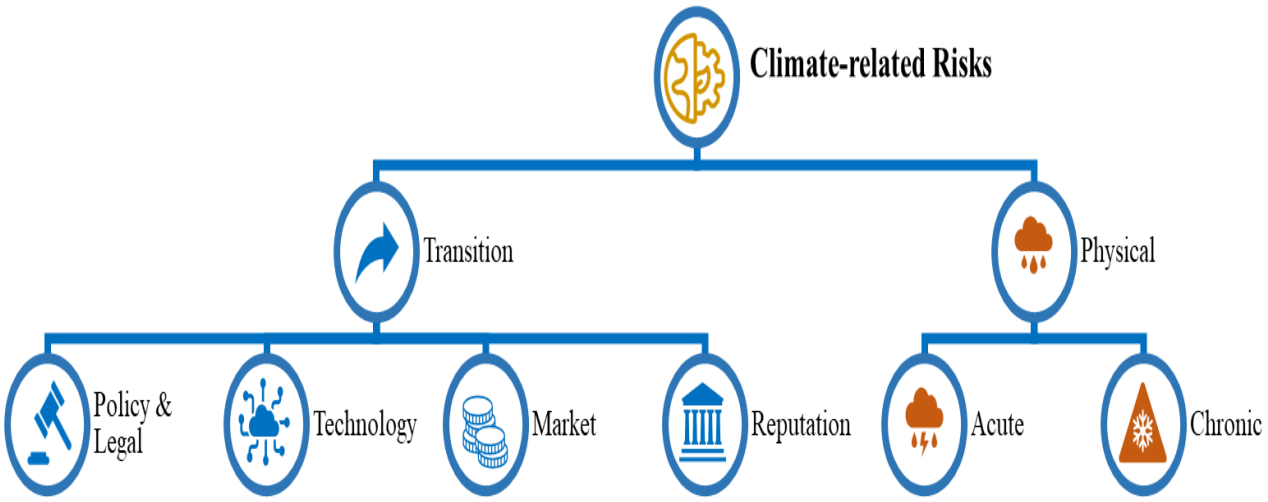
Environmental, Social, and Corporate Governance (ESG) is an extension of CSR. It is apparent worldwide that the last decade policymakers are aiming to follow and introduce ESG in their policy agendas. Governments impose strict regulations on the secondary and tertiary sectors, aspiring to minimize environmental externalities and social discrimination. More specifically, the European Union has become a global-leader in the ESG framework by institutionalizing the – environmental and social – aspects into its policy armamentarium. Institutional frameworks have been developed in order to cover these aspects in corporate governance. In essence, the EU Taxonomy has been developed as an attempt to incentivize investors and other stakeholders, who focus on ESG matters as core corporate aspects.

There is no equilibrium in the addressed needs of ESG, this is the reason why policymakers are attempting to harmonize such issues. From the three-faceted policy of ESG, "G" for corporate

governance is unequivocally the most advanced aspect referring to quantitative analysis. Next in order, "E" for environmental governance follows on the matter of maturity in the monitoring of externalities to the environment, nevertheless the "S" for Society is the least addressed issue in a plethora of challenges, inter alia, the negligence and ignorance of peoples' needs leading to social exclusion.

Climate-related risks must be answered in the sustainability reporting as external factors that can pressure business operations. The Task Force of Climate-related Financial Disclosures (TCFD) categorized climate-related risks into (i) transition, (ii) and physical (TCFD, 2017). The transition risks include issues such as (a) policy and legal risks, (b) technology risks, (c) markets risks, and (d) reputation risks. Moreover, the physical risks are composed by acute (e.g., floods etc.) and chronic (e.g., chronic heatwaves etc.). A brief representation of the above phenomena is depicted at Figure 1.

**Figure 1:** The climate-related risks.



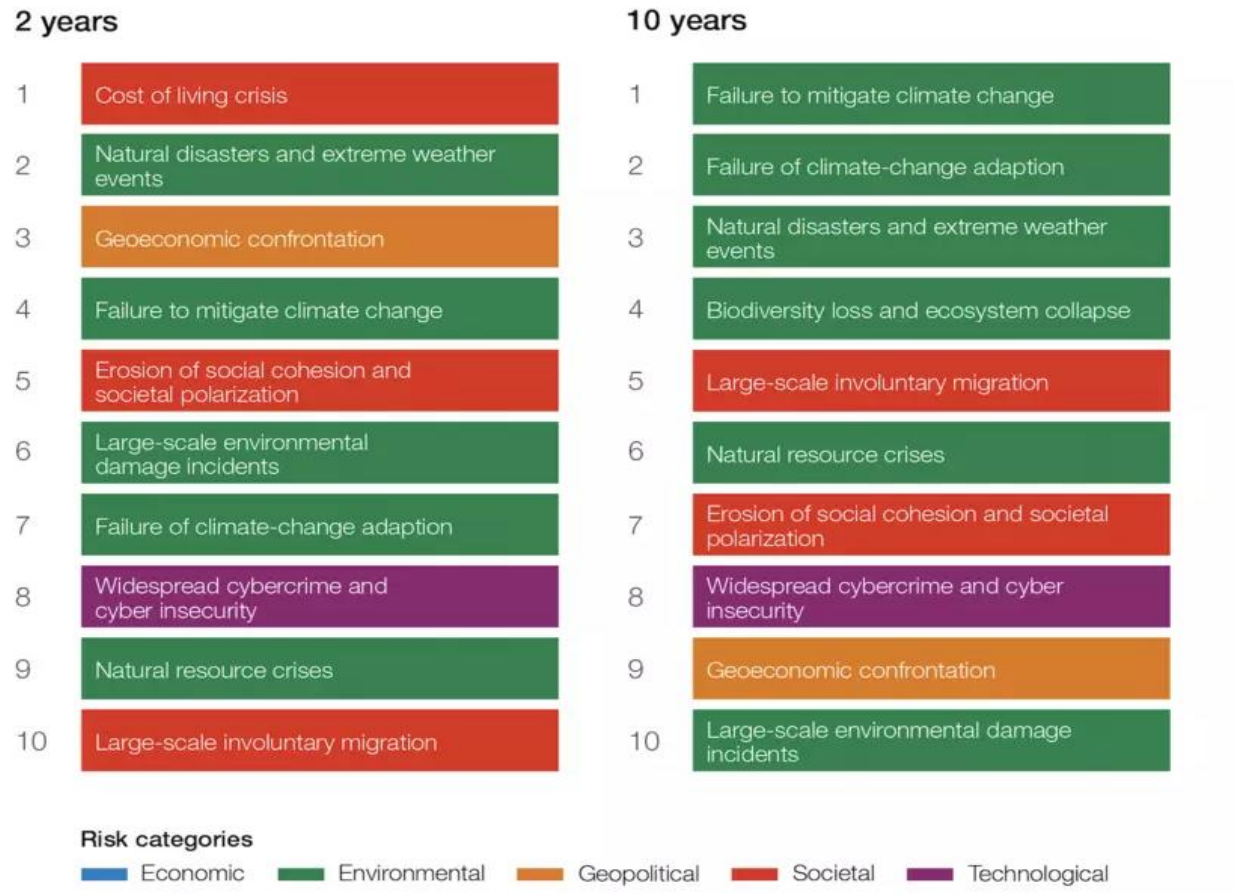

Source: Figure created by the authors based on TCFD (2017).

Global risks are trembling the pillars of sustainable development, i.e., environment, society, and economy. ESG observes the implications of the above – transitional or physical – phenomena. Furthermore, the Global Risks Report by the World Economic Forum (WEF) presented a broader scope of multi-crisis aspects. More specifically, WEF (2023) presented the top-10 environmental, economic, geopolitical, societal, and technological risks (Figure 2).

Regarding the top-10 risks of the following decade, the core problems are environmental (i.e., 5 environmental problems out of the total 10 risks), inter alia, two climate change problems (i.e., mitigation and adaptation), extreme natural disasters, biodiversity loss, and large-scale environmental challenges. The rest problems are two societal (i.e., large-scale involuntary immigration and erosion

of social cohesion), one technological (i.e., cybercrimes), and one geopolitical (i.e., wars and conflicts).

**Figure 2:** Top 10 short- and meso-term risks of the 2023 Global Risks Report.




Source: WEF (2023).

Arguably, the above categorization gives a quick glance at the challenges that humankind is going to confront the years to come. A plethora of challenges have erupted, which are interlinked with the multi-crisis phenomenon. Therefore, the ESG framework ought to be developed, aiming to minimize environmental impacts from the industrial and services sectors to the environment with respect to society's needs as well. Briefly, ESG necessitates for the absorption of corporate risks and dangers, compliance with the regulatory and institutional framework, amelioration of company's efficiency, and stakeholders' engagement.

The novelty of the present research is to monitor through three ESG indicators the global performance regarding the variables: (i) energy intensity, (ii) life expectancy, and (iii) political stability and absence of violence. Moreover, the ESG framework is observed under the scopes of circular economy model and sustainable development. Section 2 is the literature review about the interlinkages of ESG with CE and sustainable development, Section 3 is the presentation of the

dataset and the descriptive statistics. Section 4 is attributed to the results and discussion, whereas Section 5 concludes the paper and provides several ESG-related policy implications. Two research questions (RQ) are the following:

*RQ1: What are the interlinkages between ESG and circular economy?*
*RQ2: How the ESG framework is related to SDGs?*

## 2. Importance of ESG: how to evaluate ESG index

Why ESG framework is important for a company? Corporations want to achieve several targets, however a company ought to operate with a preventive strategy in the international arena. A way to make this target a reality is through the proper construction of an ESG index. It is advisable that several diverse parameters be included at this index in order to cope with environmental aspects (e.g., Scope 1 or 2 emissions), social issues (e.g., diversity, equity, and inclusion, DEI) and core governance parameters (e.g., code of company's ethics, external audit, or female representation).

### *2.1. Creating an ESG index*

A well-rounded ESG framework is not a theoretical perspective, but a tangible implementation of methods, solutions, and strategies based on pure empirical background that aims to boost the overall ESG performance. Six general steps for the creation of an ESG index are:

**Step 1**: Evaluation of corporate performance for each ESG parameter.
**Step 2**: Categorization of ESG sub-indices based on their significance.
**Step 3**: Data gathering, as only data can lead to stable and reliable analysis.
**Step 4**: The weighting of ESG parameters again based on their impact and importance.
**Step 5**: Harmonization between the corporate and the ESG performances. Therefore, it is pivotal for a company to assess whether it follows or not the ESG framework.
**Step 6**: Combination of the ESG scoring with the corporate performance, this step is the summing of the previous steps in order to extract the overall ESG index.

To recapitulate, the above methodology is a practical way to develop an ESG index suitable for companies and organizations. The only prerequisite is to follow the stakeholders' engagement on all the methodology steps in line with the company's core strategy. There are, unequivocally, differences among each industrial or services sector, therefore the harmonization of the methodology ought to follow the company's structure and culture.

## *2.2. ESG Reporting and the importance of KPIs*

The success of a reporting system is mirroring the core structure of a market. The European Union (EU) and the United States of America (USA) have invested great amount of capital and human resources in the harmonization of reporting system. This reporting system is also in tandem with the sustainable development pathway and especially with green finance. Poolen (2022), Koundouri et al. (2024), and Doukas et al. (2023) mentioned as core ESG frameworks: International Sustainability Standards Board (ISSB), EU Taxonomy, Corporate Sustainability Reporting Directive (CSRD), and Sustainable Finance Disclosure Regulation (SFRD).

The institutional framework is the pinnacle of the sustainability reporting. Firstly, the ISSB was announced at COP26 in 2021 by the IFRS Foundation (IFRS, 2022). ISSB is built upon four objectives: (i) standardization for sustainability disclosures, (ii) covering of investors' needs, (iii) transparency between companies' sustainability performance and capital markets, and (iv) interoperability among other disclosures. Apart from the International framework there is specific effort in the EU for transparency as well.

**Table 1:** Frequent utilized KPIs in the ESG framework.

| Environmental | Social | Corporate Governance |
|---|---|---|
| • Greenhouse gas emissions.<br>• Emissions intensity.<br>• Energy use, mix, and intensity.<br>• Water usage.<br>• Climate risk mitigation. | • CEO and Gender Pay ratios.<br>• Diversity, Equity and Inclusion.<br>• Non-discrimination.<br>• Number of work-related injuries.<br>• Human rights.<br>• Annual number of employee resignations.<br>• Age and race ratio of the company's employees. | • Demographic structure of the Board of Directors.<br>• Stakeholders' right to vote.<br>• Anti-corruption schemes.<br>• ESG Reporting.<br>• External audit.<br>• Total number of misconducts with institutional framework. |

The European Green Deal (EGD)[1] for the climate and energy goals for 2030, more specifically, in line with the EGD are the EU Taxonomy and CSRD. The EU Taxonomy is a core institutional framework in the EU regarding the sustainability reporting. Moreover, the CSRD and the is under the framework of the European Sustainability Reporting Standards (ESRS), whereas the SFRD would strengthen the transparency efforts on disclosing sustainability information (European Parliament,

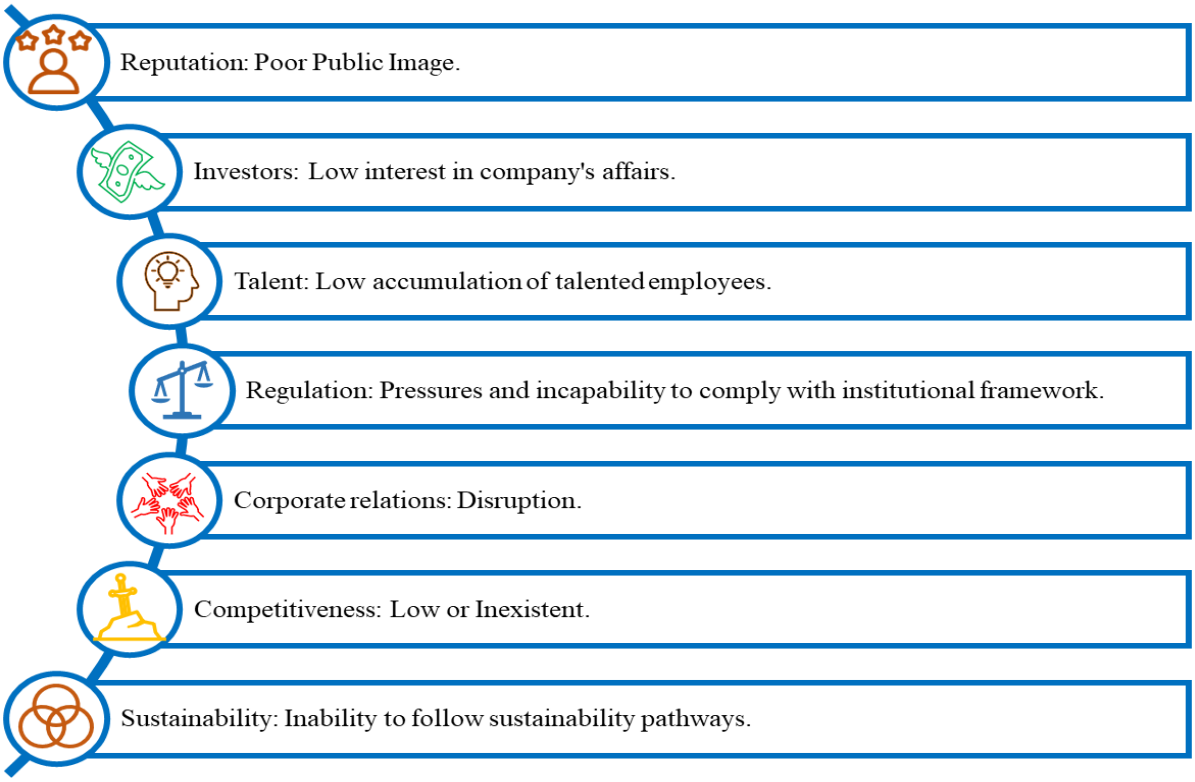
[1] For more information about the EGD please see: EC (2019) and Von-der-Leyen (2019).

2023, 2022). Essentially, Poolen (2022) noted that the CSRD contains the EU Taxonomy, but not the ISSB.

The institutional framework is based upon the disclosure of financial on non-financial information, the success of which is based upon the choice of the most essential KPIs. Table 1 presents some KPIs that have been applied in a series of ESG reports from Nasdaq (2019) and EFFAS & DVFA (2010).

Seven potential problems that can erupt, if the ESG framework is not implemented, are presented at Figure 3. The reputation of a company might be in poor condition if it does not follow the ESG framework due to the ignorance of environmental and social aspects. Investors, for instance, might have low interest on the company's affairs due to lack of ethical code.

**Figure 3:** Potential risks of not following ESG.




Source: Authors' elaboration.

Company's culture is crucial for the stimulation of – present or potential – employees. Lack of company culture can lead to lower accumulation of talented people, diminish the company's overall performance. Furthermore, the disruption of corporate relations is undoubtedly unavoidable, as the employees might feel disadvantaged or dissatisfied by their non-inclusion in the company's decision-making process. Ultimately, regulatory pressures might also appear because of the incapability to adhere to the international or European institutional framework.

Sustainability and competitiveness are part and parcel of the ESG framework. Large firms are going to disclose their ESG performance, however if a company is unwilling to disclose such information, it might be a sign of lower competitiveness against its competitors. Sustainability issues might also arise as there would be inability to follow sustainable development pathways. It is therefore important to incorporate ESG parameters in order to avoid the seven aforementioned challenges.

## *2.3. Ecological and Carbon Footprint*

The notion of biological capacity (BC) or biocapacity is crucial for the analysis of ecological footprint (EF). BC of earth is the ability to absorb negative externalities, for instance air or soil pollution. In a recent review, Matuštík and Kočí (2021) presented several environmental footprint indicators, as they have not only monitored EF and carbon footprint (CF), but also the notions of material, water, and land footprints.

**Table 2:** Differences between ecological and carbon footprint

| Ecological Footprint | Carbon Footprint |
|---|---|
| • The utilization of renewable and non-renewable energy sources.<br>• It includes either the carbon emissions or the environmental impacts.<br>• EF is used to evaluation the global consumption.<br>• It is highly interconnected with earth's sustainability. | • The total $CO_2$ emissions from different activities.<br>• It includes solely the carbon emissions.<br>• It is central to the creation of carbon credit marketplace.<br>• It is linked directly to climate change. |

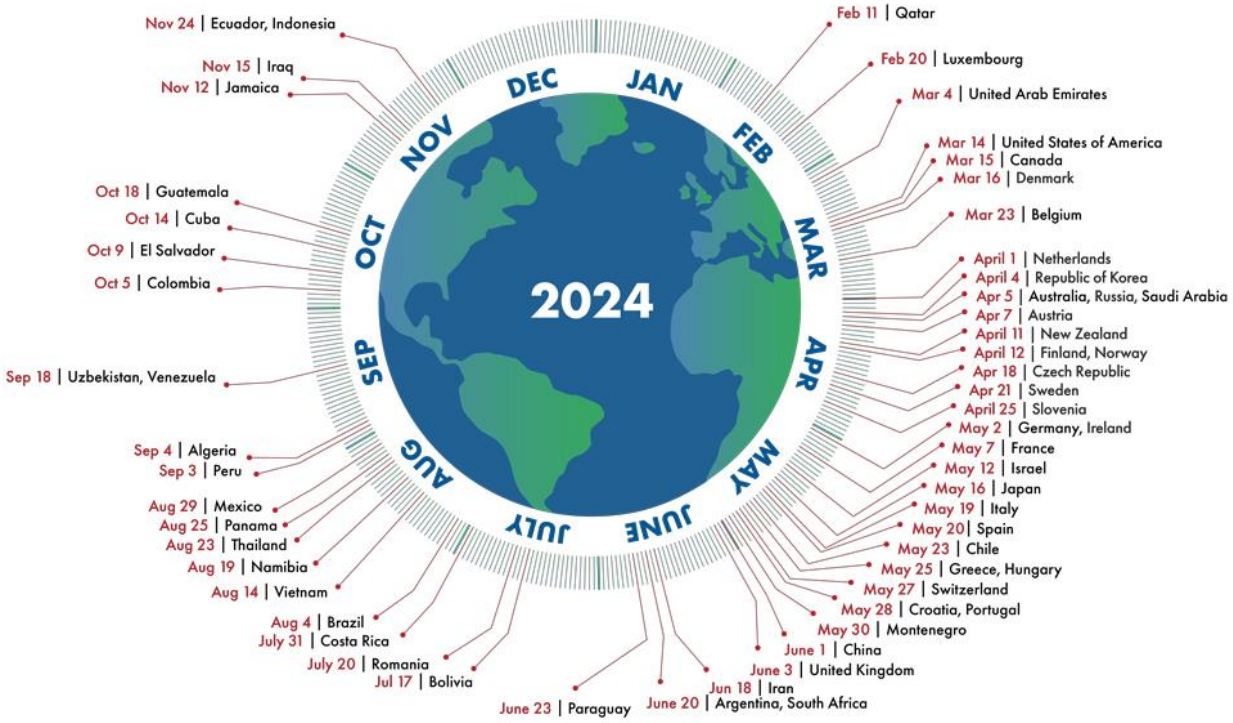
Nevertheless, this BC is under the strain of several parameters, inter alia, the increase of global population or over-consumption that leads to further air or soil pollution (Fu et al., 2020; Mancini et al., 2016; Martínez-Rocamora et al., 2017; Pandey et al., 2011; Sommer and Kratena, 2017). Hence, if BC is lower (greater) than EF there is ecological deficit (surplus), in addition, it is noteworthy to mention that there are differences between the EF and CF as presented at Table 2.

Arguably, BC is interesting as it is a measure that can observe what a country really consumes during a year. NFBA (2023) has presented some examples of excessive consumption trends in some countries as Qatar and Luxembourg that their biological deficit begins after 10 and 14 of February respectively. Accordingly, Ecuador and Jamaica are reaching their limits at 6 and 20 of December in 2022.

On the other hand, the novel BC accounts by NFBA (2024) showed, at Figure 4 that now Qatar and Luxembourg have ameliorated their performance, the former by one day and the latter by 6 days.

However, Ecuador has lost 12 days and Jamaica almost a month. Overall, there is a diverse performance, but the idea is that all of these countries express biocapacity deficit, leaving enough room of improvement for self-reliance in environmental terms. Next in order, the linkage of the ecological footprint to the broader framework of sustainable development is going to be explained.

**Figure 4:** Biological capacity in 2024.




Source: NFBA (2024).

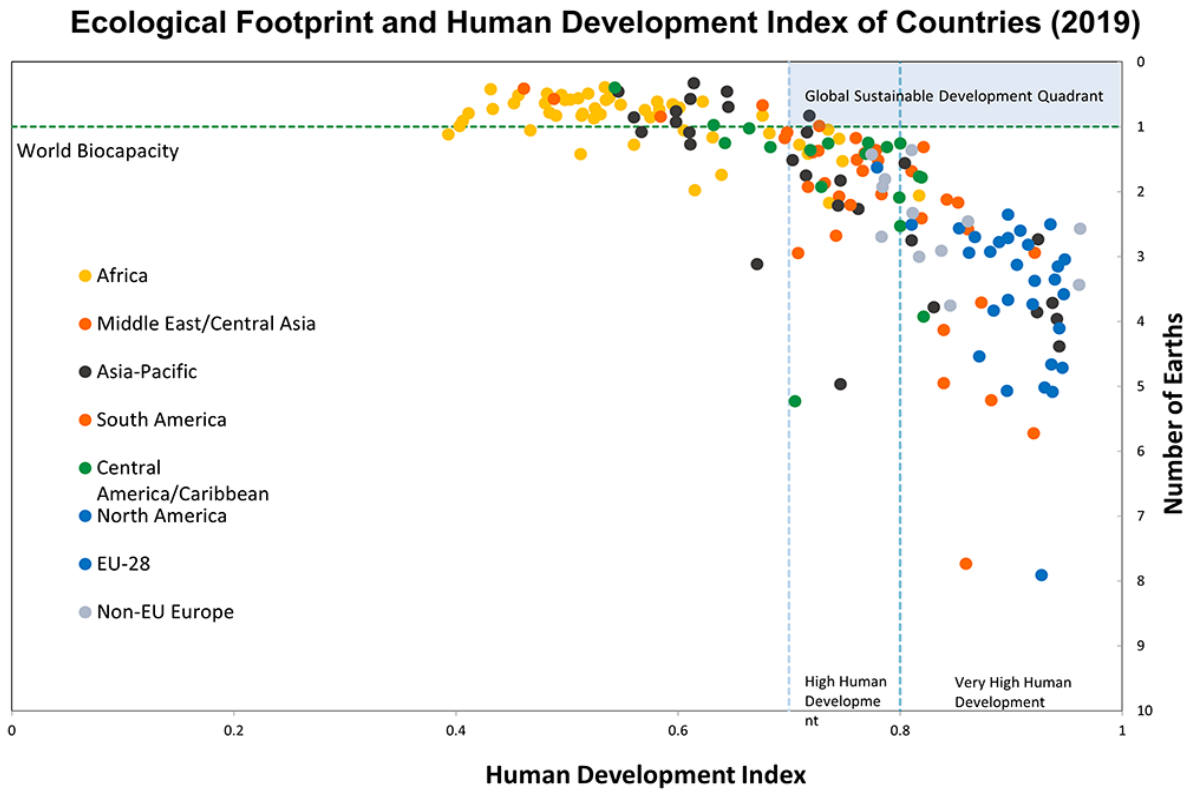
ESG framework is dynamic and can be linked to human development. A novel trend in environmental economics is to monitor how companies or the society can impact the human development. For example, the impact of economic growth can be depicted through the comparison of an ecological footprint index (e.g., the number of earths) to the human development index (HDI) (Boutaud, 2002).

Moreover, Wackernagel et al. (2017) criticized the softness of environmental policies to promote the core sustainability principles. The planetary constrains of "*one Earth*" is pivotal, as it is often neglected in order to achieve higher profitability and economic growth, nevertheless only by respecting the one earth constrains it is possible to talk about sustainable development.

Figure 5 shows the comparison of HDI by denoting in the blue colored quadrant the interconnection between ecological footprint and sustainable development. The figure explicitly illustrates that there are few countries that follow the sustainable pathway. More specifically, African countries are mainly consuming as much as one Earth can produce, but they have enough room of

improvement in the HDI. On the other hand, the European (either EU or non-EU) and American (either northern or southern) countries have great values of HDI, but they extravagantly consume equal to 2, 3, or even 8 earths.

**Figure 5:** Ecological footprint and HDI in 2019.




Source: Global Footprint Network (2019).

## 2.4. *ESG and Circular Economy*

Circular economy (CE) is indispensable part of the ESG framework. RQ1 would be addressed on this specific chapter. The transition from the linear (or Fordic[2]) to circular model can lead to less waste generation and carbon emissions (Antonakakisetal., 2017; Pintilie, 2021; Winansetal., 2017). For example, the CE framework has been evaluated in terms of ecological productivity as a measure of a country's performance (Halkos and Aslanidis, 2023b, 2023c; Haupt et al., 2017).

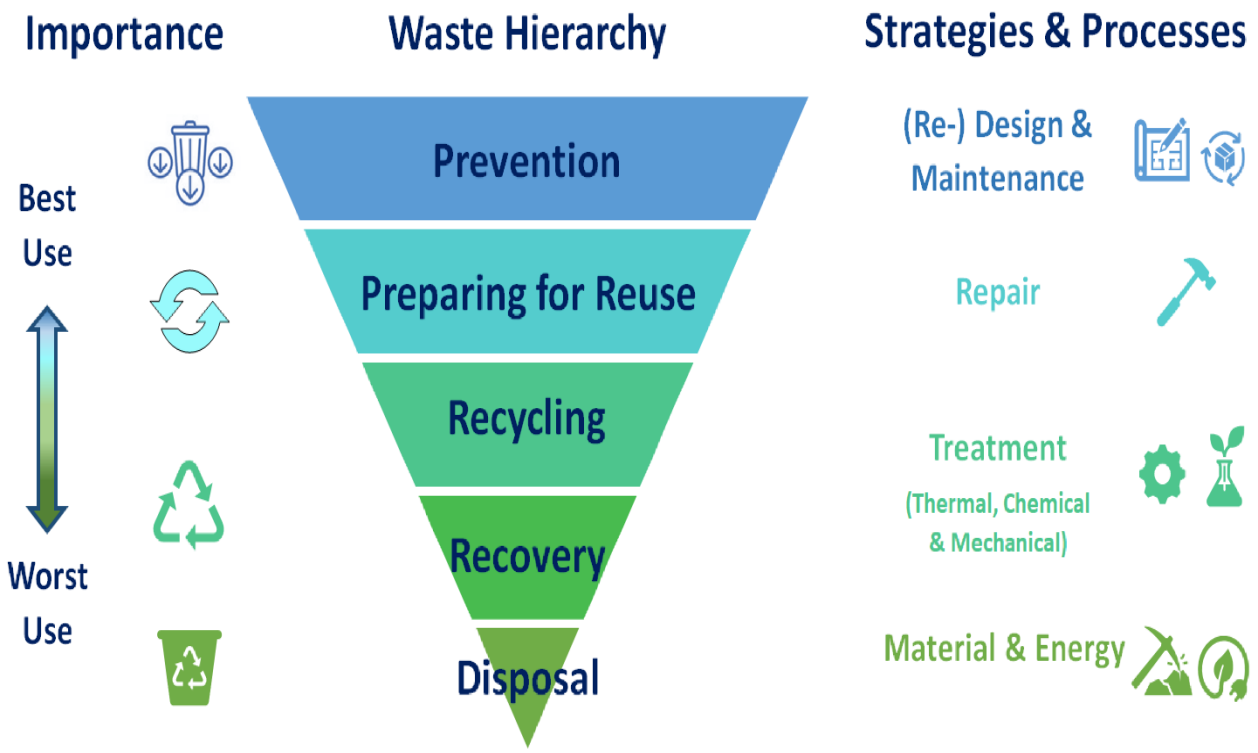
Figure 6 presents the five main level of the *waste hierarchy*[3] as well as other issues like their importance (e.g., what is best to follow) or strategies and processes to achieve a better performance. Waste hierarchy's most important strategy is *prevention*, which is central to the ESG framework on

[2] For more information about the linear model, please see Jessop (1995), Antonio and Bonanno (2000), and Halkos and Aslanidis (2024a).
[3] For more information about the European framework on waste hierarchy, please see EC (2008), EU (2018), and Halkos and Aslanidis (2024b).

the matter that a company ought to know what to do in order to prevent any possible negative environmental externality.

Moreover, the next three stages of waste hierarchy, i.e., preparing for reuse, recycling, and recovery, should be also monitored by a company, aiming to remanufacturing techniques that can lead to higher value-added and less waste too. Lastly, the level of disposal is the least desirable option from a CE perspective, nevertheless it is unavoidable.

**Figure 6:** Strategies and processes of the waste hierarchy




Source: Halkos and Aslanidis (2024a).

Waste hierarchy as presented at the above figure is necessary for the ESG framework, as it covers many issues and reasons to avoid negative externalities (Halkos and Aslanidis, 2024b). The adherence to the waste hierarchy framework is also desirable for the stakeholders. Stakeholders would like to be informed about the green ways to cope with climate change or the waste crisis, in essence stakeholders want the best reputation for the company and compliance with the institutional framework as mentioned before at Figure 3.

The alignment of CE scope with the ESG performance might be a win-win situation that will create a virtuous cycle in the company, either for its brand name or for the avoidance of fees and taxes due to adherence to the regulatory schemes. Overall, the adoption of CE solutions might build the resilience of a company under the ESG framework.

### *2.5. ESG and SDGs: similarities and differences*

The United Nations (UN) presented the 17 SDGs in 2015 and blueprinted the Agenda 2030 (UN, 2015). There is no clear linkage, however, between all of the SDGs and the ESG framework, but the ESG can support the endeavor to achieve the SDGs through actions and strategies that promote human development in companies and enterprises (Franco et al., 2021; Kumar Soni, 2023). RQ2 is going to be addressed on this section.

More specifically, the ESG can be a driving force for the conclusion of the SDGs by the pressure of stakeholders. One core difference is that there is not a clear term for the ESG, whereas the SDG scheme is well-structured.

The ESG framework has a generic methodology, as presented also at the present study, but the SDGs are wholly justified, specified, and measurable based on the UN methodology. This phenomenon is not a drawback, as the SDGs are created to be applied to each and every country, however the ESG structure ought to change in order to be easily practiced and tested on diverse corporate environments.

SDGs also have a specific time period that must be completed (i.e., Agenda 2030 and Agenda 2050), while ESG does not follow a specific timeline. It is noteworthy that SDGs allow for an unbiased framework for their completion, but ESG is at stake of "greenwashing", meaning that some companies utilize the ESG nomenclature not in order to follow a more sustainable pathway, but solely for profitability reasons.

## 3. Materials and Methods

The present study has retrieved from the Sovereign ESG Data Portal by the World Bank Group (2024) three ESG indicators in order to measure the countries' ESG performance. The environmental-related indicator is energy intensity level of primary energy in 2019 (MJ/$2017 PPP GDP), the social-centric is the life expectancy at birth (years) in 2020, whereas the governance-specific indicator is political stability and absence of violence/terrorism (estimate) in 2020.

The case studies are 173 countries for the whole world and the data are going to be monitored at a continental scale. The choice of each indicator is based on stakeholders' need, for instance energy intensity covers the matter of CE, life expectancy is a parameter that every stakeholder bears in mind, whereas political stability and absence of violence provides a reliable and risk-free environment for companies and especially for investors.

Table 3 presents the descriptive statistics for the three ESG indicators. More specifically, all three parameters reject the null hypothesis of normality based on the Jarque-Bera results in Table 3, as well as Appendix A (Figure A.1) shows the histograms that lead to the same conclusion.

Furthermore, there is negative correlation between energy intensity with both political stability and life expectancy, but positive relation between political stability and life expectancy.

**Table 3:** Descriptive statistics for the continental and global scales of the ESG indicators.

| | Min | Mean | Median | Max | StD | Jarque - Bera |
|---|---|---|---|---|---|---|
| ***Africa*** **(n=49)** | | | | | | |
| Political Stability | –2.52 | –0.71 | –0.60 | 1.09 | 0.82 | 21.91* |
| Energy Intensity | 1.89 | 5.82 | 4.99 | 14.33 | 2.99 | 21.57* |
| Life Expectancy | 53.68 | 64.59 | 64.19 | 77.24 | 6.00 | 20.74* |
| ***Americas*** **(n = 31)** | | | | | | |
| Political Stability | –1.04 | 0.17 | 0.17 | 1.13 | 0.65 | 22.23* |
| Energy Intensity | 1.27 | 4.03 | 3.39 | 19.90 | 3.21 | 520.30* |
| Life Expectancy | 64.32 | 75.29 | 74.75 | 81.75 | 3.48 | 3.88 |
| ***Asia*** **(n=44)** | | | | | | |
| Political Stability | –2.73 | –0.36 | –0.38 | 1.47 | 0.96 | 17.28* |
| Energy Intensity | 1.78 | 4.92 | 4.62 | 11.12 | 2.16 | 19.03* |
| Life Expectancy | 54.84 | 73.80 | 73.52 | 84.62 | 5.59 | 4.62 |
| ***Europe*** **(n=39)** | | | | | | |
| Political Stability | –1.16 | 0.53 | 0.61 | 1.39 | 0.56 | 12.52* |
| Energy Intensity | 1.32 | 3.65 | 3.29 | 12.27 | 1.90 | 139.04* |
| Life Expectancy | 71.19 | 78.95 | 80.80 | 83.21 | 3.49 | 27.31* |
| ***Oceania*** **(n=10)** | | | | | | |
| Political Stability | –0.74 | 0.82 | 0.96 | 1.49 | 0.60 | 12.68* |
| Energy Intensity | 2.15 | 4.29 | 4.29 | 5.93 | 1.12 | 3.43 |
| Life Expectancy | 64.73 | 72.24 | 70.82 | 83.20 | 6.08 | 5.09 |
| ***Total Countries*** **(N=173)** | | | | | | |
| Political Stability | –2.73 | –0.09 | –0.05 | 1.49 | 0.92 | 80.39* |
| Energy Intensity | 1.27 | 4.69 | 3.94 | 19.90 | 2.65 | 255.52* |
| Life Expectancy | 53.68 | 72.53 | 73.92 | 84.62 | 7.33 | 93.40* |

Note: * denotes statistical significance at 5%.

## 4. Results and Discussion

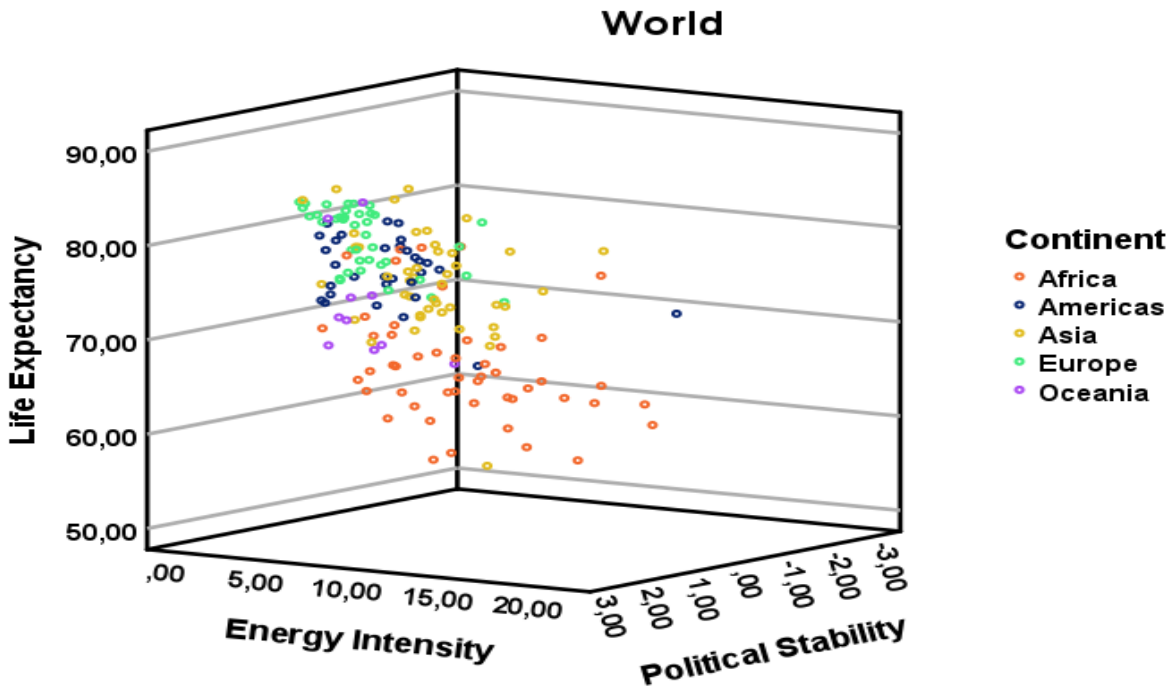
The average ESG performance based on the three indicators, i.e., political stability, energy intensity, and life expectancy, a global scale can allow for comparison of the top performers and the laggards. Moreover, Table 4 illustrates the average continental ESG performance, aiming to show which continents are following or staying behind these significant business-related factors.

**Table 4:** Average continental ESG performance.

| **Continents** | **ESG Indicators** | | |
|---|---|---|---|
| | **Political Stability** | **Energy Intensity** | **Life Expectancy** |
| ***Africa*** | ↓ | ↑ | ↓ |
| ***Americas*** | → | → | ↑ |
| ***Asia*** | ↓ | → | → |
| ***Europe*** | → | ↓ | ↑ |
| ***Oceania*** | ↑ | → | → |

Essentially, as depicted at Figure 7 and Appendix B (Figure B.1), Americas and Oceania show the best performance regarding the average ESG performance followed by Europe, Asia, and lastly by Africa. Interestingly, Asia on this table can be deemed laggard, even though many Asian countries are emerging rapidly in their business performance. Apparently, Africa should be strengthened on the ESG framework as it shows the lowest average ESG performance, especially in political stability and violence as well as in the factor of life expectancy.

**Figure 7:** Global ESG performance based on the three indicators.




Africa has a relatively low performance in the estimate for political stability and absence of violence. Moreover, Africa has also the lowest life expectancy, therefore there is alertness on this social aspect. The top performers of Africa for political stability are Botswana, Seychelles, and Namibia, for energy intensity are Liberia, Congo, and Mozambique, whereas for life expectancy Seychelles, Algeria, and Morocco.

Americas has a very good performance on life expectancy equal with 75 years with top-performers Canada, Costa Rica, and Chile. Political stability's best performance can be found in Barbados, Canada, and Uruguay, additionally, Trinidad and Tobago, Canada, and Belize achieved a good energy intensity performance.

Asia has a relatively mediocre performance on energy intensity and life expectancy with 4.92 (MJ/$2017 PPP GDP) and 73.8 (years) average values respectively. The best performance in energy intensity can be found in Iran, Bahrain, Uzbekistan, next in order a good performance in life expectancy can be linked to Japan, Singapore, and South Korea.

Europe needs to focus more on energy intensity, where the top-performing countries are Iceland, Ukraine, and Bosnia and Herzegovina. The political stability variable has a well-structured result in Iceland, Norway, and Luxembourg, whereas the best life expectancy in Norway, Switzerland, and Iceland.

**Table 5:** Continental comparison on three ESG indicators.

| | **Top Performers** | **Laggards** |
|---|---|---|
| ***Africa*** | | |
| Political Stability | Botswana, Seychelles, Namibia | Somalia, Libya, Central African Republic |
| Energy Intensity | Liberia, Congo, Mozambique | Djibouti, Botswana, Ghana |
| Life expectancy | Seychelles, Algeria, Morocco | Central African Republic, Chad, Nigeria |
| ***Americas*** | | |
| Political Stability | Barbados, Canada, Uruguay | Haiti, Mexico, Colombia |
| Energy Intensity | Trinidad and Tobago, Canada, Belize | Cuba, Panama, Dominican Republic |
| Life expectancy | Canada, Costa Rica, Chile | Haiti, Guyana, Bolivia |
| ***Asia*** | | |
| Political Stability | Singapore, Brunei Darussalam, Japan | Afghanistan, Irak, Pakistan |
| Energy Intensity | Iran, Bahrain, Uzbekistan | Sri Lanka, Timor-Leste, Mauritius |
| Life expectancy | Japan, Singapore, South Korea | Lesotho, Afghanistan, Sudan |
| ***Europe*** | | |
| Political Stability | Iceland, Norway, Luxembourg | Ukraine, Belarus, Bosnia and Herzegovina |
| Energy Intensity | Iceland, Ukraine, Bosnia and Herzegovina | Ireland, Malta, Switzerland |
| Life expectancy | Norway, Switzerland, Iceland | Ukraine, Moldova, Bulgaria |
| ***Oceania*** | | |
| Political Stability | New Zealand, Samoa, Kiribati | Papua New Guinea, Solomon Islands, Fiji |
| Energy Intensity | Kiribati, Federated States of Micronesia, Papua New Guinea | Fiji, Tonga, Vanuatu |
| Life expectancy | Australia, New Zealand, Samoa | Papua New Guinea Fiji, Federated States of Micronesia |

Oceania has one of the best performances regarding political stability, with New Zealand, Samoa, and Kiribati as pioneers. Nevertheless, there is mediocre performance regarding energy intensity and life expectancy, for the former variable the best performance can be observed in Kiribati,

Federated States of Micronesia, and Papua New Guinea, while the top-performs for life expectancy Australia, New Zealand, and Samoa.

Essentially, the recognition of the top-performers can enable policymakers to gain insight of that practices can lead to better ESG performance. Additionally, it is important to monitor other parameters that can inform investors or other stakeholders about general issues such as social cohesion, environmental responsibility, and proper corporate governance.

## 5. Conclusions and Policy Implications

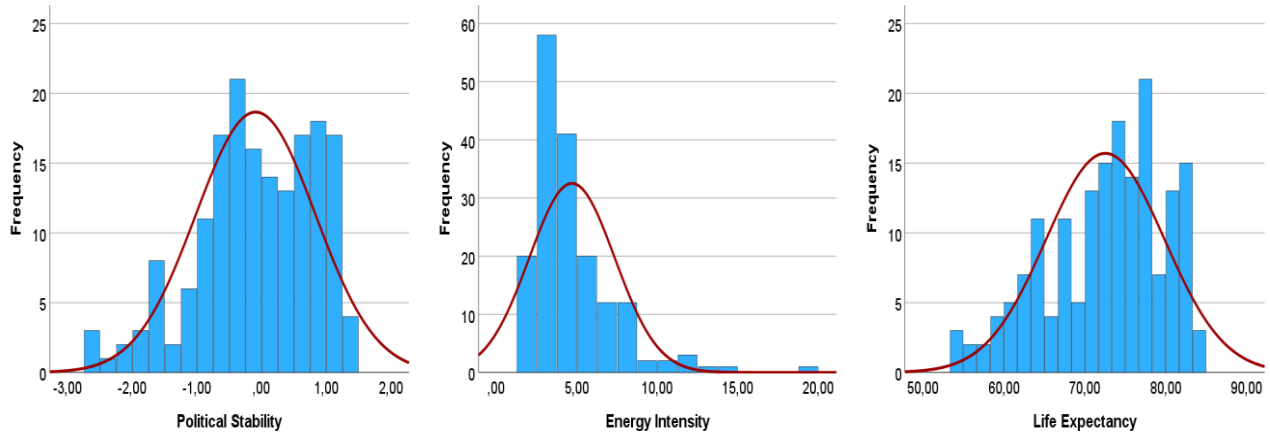
The multi-crisis era has proliferated a series of risks and dangers, generally against the environment and the society, and specifically towards business and organizations. The ESG framework has answered to this challenge with a technical armamentarium that tries to boost business performance and to respect environmental and societal needs. In essence, the alignment of ESG with SDGs promotes a well-rounded approach to sustainability. Some policy implications that can help companies to boost their ESG performance are:

- Adherence to the institutional and regulatory framework would reduce the payment of fees or taxes, leading to lower external pressures and a well-rounded audit.
- Companies should invest time on building a compact and inclusive code of ethics, upon which the company culture is going to be based.
- Corporate governance is reinforced by the ESG-SDGs interconnection, transparency, and accountability.
- Successful ESG reporting would allow employees to feel part of their company, leading to greater productivity. Moreover, ESG reporting would show to potential employees that they can fit in the company's culture, attracting more talented people as well. Overall, a company can increase its social footprint by implementing ESG factors.
- Circular economy solutions would strengthen the ESG reporting efforts. CE is also a prerequisite of the SDGs, for instance through the extension of raw materials life. The adoption of CE and ESG criteria can allow companies to achieve a sustainable future.
- Policymakers should also take into consideration that the overall continental or regional performance can affect the business sector, as investors would seek risk-free places to operate. The spatial factors of ESG are covered both, environmental and social, pillars.
- International organizations should make effort to ameliorate the laggards, either countries or regions. The catching up of the least developed places would not only strengthen the ESG framework, but it will promote the success of SDGs.

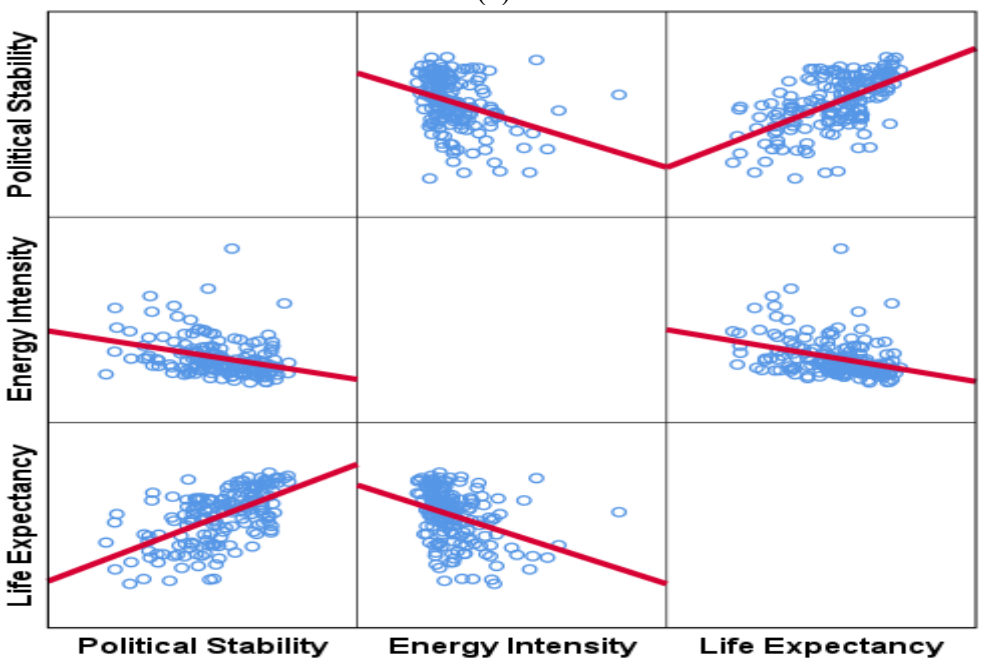
To recapitulate, it is apparent that SDGs can be enforced for the creation of a more sustainable future, but the ESG is at stake due to no clear timeline and greenwashing illicit techniques. ESG cam accelerate the transition from the linear to circular economy and achieve at SDGs prerequisites. In short, a holistic ESG framework can augment the business sector resilience against long-term external pressing factors and driving forces based solely on realistic targets and profitable aspirations.

## Appendix A

**Figure A.1:** Histograms (a) and correlogram (b) of the three ESG indicators.



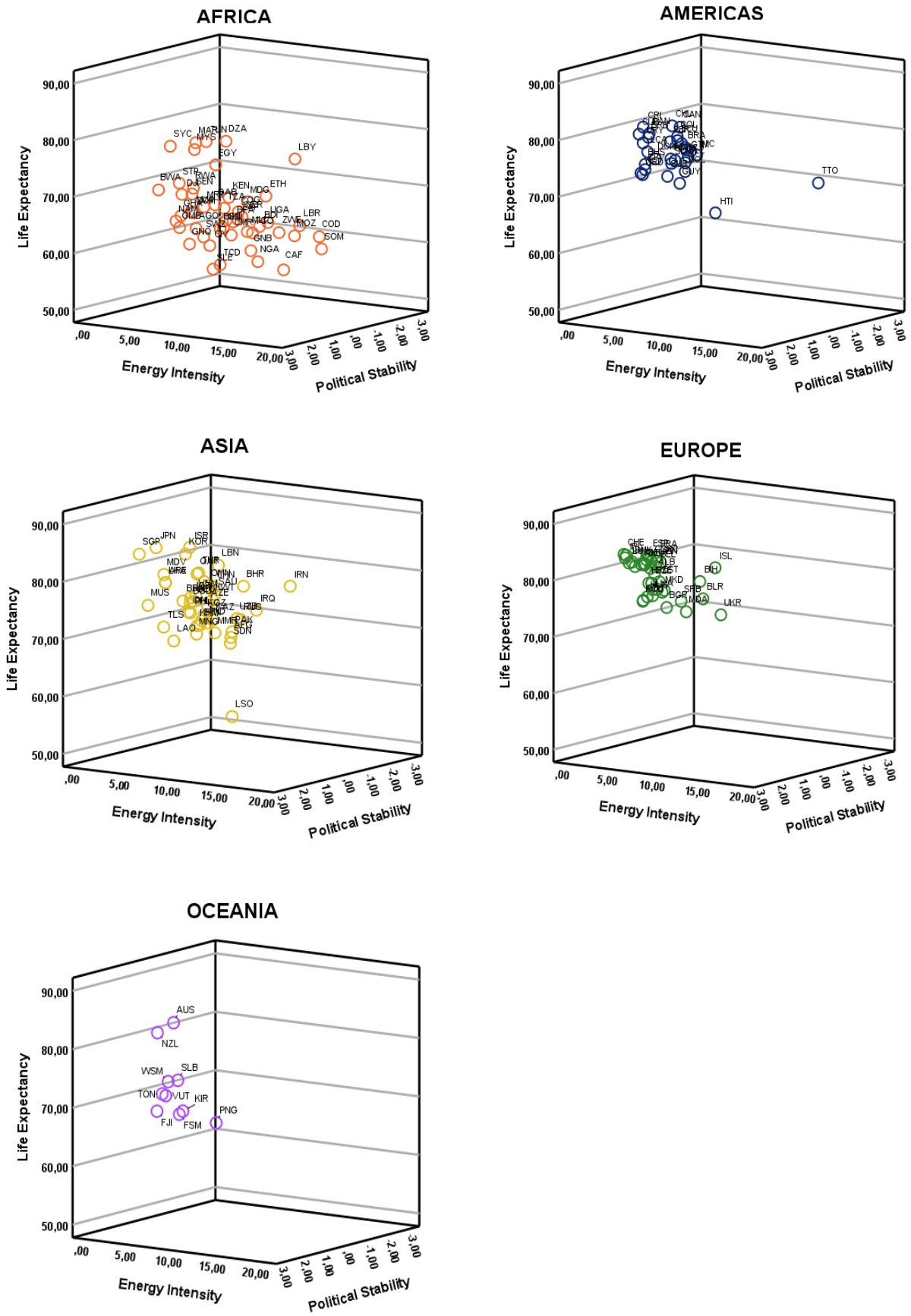

(a)




(b)

# Appendix B

**Figure B.1:** Continental comparison on three ESG indicators.



## References


Adnan, M., Xiao, B., Xiao, P., Zhao, P., Bibi, S., 2022. Heavy Metal, Waste, COVID-19, and Rapid Industrialization in This Modern Era—Fit for Sustainable Future. Sustain. 14. https://doi.org/10.3390/su14084746

Antonakakis, N., Chatziantoniou, I., Filis, G., 2017. Energy consumption, CO2 emissions, and economic growth: An ethical dilemma. Renew. Sustain. Energy Rev. 68, 808–824. https://doi.org/10.1016/j.rser.2016.09.105

Antonio, R.J., Bonanno, A., 2000. A New Global Capitalism ? From " Americanism and Fordism " to " Americanization-Globalization ". Am. Stud. 41, 33–77.

Aslanidis, P.-S.C., Golia, E.E., 2022. Urban Sustainability at Risk Due to Soil Pollution by Heavy Metals—Case Study: Volos, Greece. Land 11. https://doi.org/10.3390/land11071016

Boutaud, A., 2002. Développement Durable: Quelques Vérités Embarrassantes. Econ. Humanisme 4–7.

Dasgupta, P., 2021. The Economics of Biodiversity: The Dasgupta Review [WWW Document]. HM Treas. URL https://assets.publishing.service.gov.uk/media/602e92b2e90e07660f807b47/The_Economics_of_Biodiversity_The_Dasgupta_Review_Full_Report.pdf (accessed 10.15.23).

Deane, P., 1979. The first industrial revolution, 2nd ed. Cambridge University Press, Cambridge.

Doukas, C., Kanellou, E., Marinakis, V., 2023. Adoption of ESG kriteria in investment decesion making: Trends and perspectives (In Greek) [WWW Document]. diaNEOsis Res. policy institute. URL https://www.dianeosis.org/wp-content/uploads/2023/12/PP_ESG.pdf (accessed 2.17.23).

EC, 2019. The European green deal. [WWW Document]. Eur. Comm. URL https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN (accessed 7.1.22).

EC, 2008. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives [WWW Document]. Off. J. Eur. Communities. URL https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0098 (accessed 12.30.22).

EFFAS & DVFA, 2010. KPIs for ESG: A Guideline for the Integration of ESG into Financial Analysis and Corporate Valuation. Version 3.0. [WWW Document]. Eur. Fed. Financ. Anal. Soc. Soc. Invest. Prof. Ger. URL https://effas.com/wp-content/uploads/2021/09/KPIs_for_ESG_3_0_Final.pdf (accessed 2.18.24).

Ekonomou, G., Halkos, G., 2023. Exploring the Impact of Economic Growth on the Environment: An Overview of Trends and Developments. Energies 16, 4497. https://doi.org/10.3390/en16114497

EU, 2018. Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste (Text with EEA relevance) [WWW Document]. Eur. Union. URL https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L0851 (accessed 2.15.23).

European Parliament, 2023. Regulation (EU) 2019/2088 on sustainability-related disclosures in the financial sector. [WWW Document]. Off. J. Eur. Union. URL https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R2088 (accessed 2.12.24).

European Parliament, 2022. Directive (EU) 2022/2464 on corporate sustainability reporting [WWW Document]. Off. J. Eur. Union. URL https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022L2464 (accessed 9.15.23).

Franco, C. De, Nicolle, J., Tran, L.-A., 2021. Sustainable Investing: ESG versus SDG. J. Impact ESG Invest. jesg.2021.1.019. https://doi.org/10.3905/jesg.2021.1.019

Fu, W., Luo, M., Chen, J., Udimal, T.B., 2020. Carbon footprint and carbon carrying capacity of vegetation in ecologically fragile areas: A case study of Yunnan. Phys. Chem. Earth, Parts A/B/C 120, 102904. https://doi.org/10.1016/j.pce.2020.102904

Global Footprint Network, 2019. Sustainable Development [WWW Document]. URL https://www.footprintnetwork.org/our-work/sustainable-development/ (accessed 2.15.24).
Halkos, G.E., 2023. Interconnectedness of Natural Capital, Social Capital, Produced Capital, and Cultural Heritage in Sustainable Development, in: EAERE 2023 28th Annual Conference. 29 June, Limassol, Cyprus.
Halkos, G.E., Aslanidis, P.-S.C., 2024a. How Waste Crisis altered the Common Understanding: from Fordism to Circular Economy and Sustainable Development. Circ. Econ. Sustain. https://doi.org/https://doi.org/10.1007/s43615-023-00337-3
Halkos, G.E., Aslanidis, P.-S.C., 2024b. Reviewing the integrated institutional framework for circular economy in the European Union. Munich Pers. RePEc Arch. MPRA Pap. No. 119774.
Halkos, G.E., Aslanidis, P.-S.C., 2023a. Sustainable energy development in an era of geopolitical multi-crisis. Applying productivity indices within institutional framework. Resour. Policy 85, 103854. https://doi.org/10.1016/j.resourpol.2023.103854
Halkos, G.E., Aslanidis, P.-S.C., 2023b. New circular economy perspectives on measuring sustainable waste management productivity. Econ. Anal. Policy 77, 764–779. https://doi.org/10.1016/j.eap.2023.01.001
Halkos, G.E., Aslanidis, P.-S.C., 2023c. Promoting sustainable waste management for regional economic development in European Mediterranean countries. Euro-Mediterranean J. Environ. Integr. https://doi.org/10.1007/s41207-023-00405-y
Halkos, G.E., Ekonomou, G., 2024. Is economic growth sustainable in the long run? The answer might not be obvious. Munich Pers. RePEc Arch. MPRA Pap. No. 119780.
Halkos, G.E., Nomikos, S.N., 2021a. Reviewing the status of corporate social responsibility (CSR) legal framework. Manag. Environ. Qual. An Int. J. 32, 700–716. https://doi.org/10.1108/MEQ-04-2021-0073
Halkos, G.E., Nomikos, S.N., 2021b. Corporate social responsibility: Trends in global reporting initiative standards. Econ. Anal. Policy 69, 106–117. https://doi.org/10.1016/j.eap.2020.11.008
Haupt, M., Vadenbo, C., Hellweg, S., 2017. Do We Have the Right Performance Indicators for the Circular Economy?: Insight into the Swiss Waste Management System. J. Ind. Ecol. 21, 615–627. https://doi.org/10.1111/jiec.12506
Hossain, S., Law, H.J., Asfaw, A., 2022. The Waste Crisis: Roadmap for Sustainable Waste Management in Developing Countries, International Solid Waste Association - WILEY. John Wiley & Sons Ltd., Oxford, UK.
IFRS, 2022. International Sustainability Standards Board [WWW Document]. IFRS Found. URL https://www.ifrs.org/groups/international-sustainability-standards-board/
Jernelöv, A., 2010. The Threats from Oil Spills: Now, Then, and in the Future. Ambio 39, 353–366. https://doi.org/10.1007/s13280-010-0085-5
Jessop, B., 1995. The regulation approach, governance and post-Fordism: Alternative perspectives on economic and political change? Econ. Soc. 24, 307–333. https://doi.org/10.1080/03085149500000013
Koundouri, P., Landis, C.F.M., Dellis, K., Plataniotis, A., 2024. Integrating SDGs in ESGs and the Sustainability Transformation of the EU Business Sector. Dep. Int. Eur. Econ. Stud. Athens Univ. Econ. Business.
Kumar Soni, T., 2023. Demystifying the relationship between ESG and SDG performance: Study of emerging economies. Invest. Manag. Financ. Innov. 20, 1–12. https://doi.org/10.21511/imfi.20(3).2023.01
Kuzemko, C., Bradshaw, M., Bridge, G., Goldthau, A., Jewell, J., Overland, I., Scholten, D., Van de Graaf, T., Westphal, K., 2020. Covid-19 and the politics of sustainable energy transitions. Energy Res. Soc. Sci. 68, 101685. https://doi.org/10.1016/j.erss.2020.101685
Majid, M., Habib, S., Javed, A.R., Rizwan, M., Srivastava, G., Gadekallu, T.R., Lin, J.C.-W., 2022. Applications of Wireless Sensor Networks and Internet of Things Frameworks in the Industry Revolution 4.0: A Systematic Literature Review. Sensors 22, 2087.

https://doi.org/10.3390/s22062087
Mancini, M.S., Galli, A., Niccolucci, V., Lin, D., Bastianoni, S., Wackernagel, M., Marchettini, N., 2016. Ecological Footprint: Refining the carbon Footprint calculation. Ecol. Indic. 61, 390–403. https://doi.org/10.1016/j.ecolind.2015.09.040
Martínez-Rocamora, A., Solís-Guzmán, J., Marrero, M., 2017. Ecological footprint of the use and maintenance phase of buildings: Maintenance tasks and final results. Energy Build. 155, 339–351. https://doi.org/10.1016/j.enbuild.2017.09.038
Matuštík, J., Kočí, V., 2021. What is a footprint? A conceptual analysis of environmental footprint indicators. J. Clean. Prod. 285, 124833. https://doi.org/10.1016/j.jclepro.2020.124833
Nasdaq, 2019. ESG Reporting Guide 2.0: A Support Resource for Companies. May 2019 [WWW Document]. URL https://www.nasdaq.com/docs/2019/11/26/2019-ESG-Reporting-Guide.pdf (accessed 12.15.23).
NFBA, 2024. Earth Overshood Days. National Footprint and Biocapacity Accounts. [WWW Document]. URL https://www.overshootday.org/newsroom/country-overshoot-days/ (accessed 2.21.24).
NFBA, 2023. Earth Overshoot Days. National Footprint and Biocapacity Accounts. [WWW Document]. URL https://www.overshootday.org/newsroom/country-overshoot-days/ (accessed 12.15.24).
Pandey, D., Agrawal, M., Pandey, J.S., 2011. Carbon footprint: current methods of estimation. Environ. Monit. Assess. 178, 135–160. https://doi.org/10.1007/s10661-010-1678-y
Pintilie, N., 2021. a Review of Europe ' S Transition From Fossil Fuels To Renewable Energy. Bus. Excell. Manag. 11, 95–108.
Poolen, D., 2022. An Introduction to the Sustainability Reporting Landscape [WWW Document]. Rabobank. URL https://www.rabobank.com/knowledge/d011294242-an-introduction-to-the-sustainability-reporting-landscape (accessed 7.20.23).
Sommer, M., Kratena, K., 2017. The Carbon Footprint of European Households and Income Distribution. Ecol. Econ. 136, 62–72. https://doi.org/10.1016/j.ecolecon.2016.12.008
TCFD, 2017. Recommendations of the Task Force on Climate-related Financial Disclosures [WWW Document]. Task Force Clim. Financ. Discl. URL https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf (accessed 9.15.23).
Tooze, A., 2022. Welcome to the world of the polycrisis [WWW Document]. Financ. Times. URL https://www.ft.com/content/498398e7-11b1-494b-9cd3-6d669dc3de33 (accessed 3.10.23).
UN, 2015. The 17 goals. [WWW Document]. United Nations. URL https://sdgs.un.org/goals (accessed 11.10.23).
Von-der-Leyen, U., 2019. A Union that strives for more: My agenda for Europe [WWW Document]. Eur. Crim. Law Rev. URL https://commission.europa.eu/system/files/2020-04/political-guidelines-next-commission_en_0.pdf (accessed 11.19.22).
Wackernagel, M., Hanscom, L., Lin, D., 2017. Making the Sustainable Development Goals Consistent with Sustainability. Front. Energy Res. 5. https://doi.org/10.3389/fenrg.2017.00018
Wadanambi, R.T., Wandana, L.S., Chathumini, K.K.G.L., Dassanayake, N.P., Preethika, D.D.P., Arachchige, U.S.P.R., 2020. The effects of industrialization on climate change. J. Res. Technol. Eng. 1, 86–94.
WEF, 2023. The Global Risks Report 2023 - 18th Edition [WWW Document]. WEF, Marsh McLennan, ZIG. URL https://www3.weforum.org/docs/WEF_Global_Risks_Report_2023.pdf (accessed 3.30.23).
Winans, K., Kendall, A., Deng, H., 2017. The history and current applications of the circular economy concept. Renew. Sustain. Energy Rev. 68, 825–833. https://doi.org/10.1016/j.rser.2016.09.123
World Bank Group, 2024. Sovereign ESG Data Portal [WWW Document]. URL https://esgdata.worldbank.org/?lang=en (accessed 1.15.24).