Green Indices and Their Role in the Implementation of ESG in the Context of Sustainable Economic Development

Tetiana Paliienko
Doctor of Philosophy in Economics,
Senior Lecturer of the Department of Economics,
National University of Kyiv-Mohyla Academy, Ukraine
E-mail: t.paliienko@ukma.edu.ua
ORCID: https://orcid.org/0000-0002-5978-0721

Vlada Diachenko
Student of the Department of Economics,
National University of Kyiv-Mohyla Academy, Ukraine
E-mail: vlada.diachenko@ukma.edu.ua
ORCID: https://orcid.org/0009-0008-1806-8886

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Abstract. *The article under scrutiny herein focuses on an in-depth examination of the pivotal role that green indices play in the promotion of sustainable economic and business development. A comprehensive analysis is undertaken to explore the influence of these indices on the attraction of investments, the shaping of corporate reputations, the generation of new employment opportunities in the renewable energy sector, and the transformation of the global labour market during the era of the green economy. The present study is of particular pertinence in light of the mounting significance of environmental, social and governance (ESG) factors in the contemporary economy, as well as the imperative to evaluate the sustainable development of enterprises within the context of global climate challenges, including potential investors seeking to allocate capital towards green projects. The purpose of the research is to study the functioning of green indices, their impact on sustainable development, investment attraction and job creation in the renewable sectors of the economy. A complex of general scientific methods (comparative analysis) and specific scientific knowledge methods (bibliometric, cluster and statistical analysis) is used in the work, which has made it possible to carry out a comprehensive analysis of publication activity and relationships between ESG fields of activity based on the Scopus database; to carry out a comparative analysis and provide characteristics for different types of green indices and highlight their role in sustainable development; and to study job creation in the renewable energy sectors. The results of the study show that "green" indices are one of the tools for the transformation of the modern economy towards environmental sustainability and serve as an effective tool to stimulate companies towards sustainable development, providing reputational, financial and strategic benefits. The research shows that the number of publications dedicated to this topic has increased significantly over the past decade, indicating an increased interest in ESG practices by the academic and business communities. The main green indices that reflect companies' adherence to the principles of sustainable development, such as assessing transparency in reporting, environmental innovation and risk management, are described. The practical benefits of these indices lie in their ability to increase the investment attractiveness of companies, encourage innovation and ensure corporate social responsibility. The authors of the study concluded that green indices have two main effects. Firstly, they are effective in stimulating companies to implement innovative sustainable practices. Secondly, they contribute to the development of new sectors of the economy, for example in the field of renewable energy. The result of these two factors is the creation of millions of new jobs around the world. This is especially relevant for countries that are trying to reduce unemployment. Consequently, the article holds practical value for companies, investors and legislative authorities of countries worldwide, offering effective tools for implementing ESG criteria, attracting investment and developing a green economy.*

Keywords: *green indices, ESG, sustainable development, sustainable investment, environmental responsibility, green jobs, renewable energy.*

JEL Classification: *M14, O44, P28, Q01, Q56*

1 Introduction

In the contemporary business environment, enterprises are confronted with a plethora of environmental risks, including climate change, resource degradation, greenhouse gas emissions, and pollution of water, air, and soil. In 2015, the United Nations (UN) member states reached a consensus on 17 Sustainable Development Goals (SDGs), with the objective of promoting a sustainable future for the planet (United Nations Development Programme, n.d.). This meant that countries and global organisations began to think about their impact on the environment, and companies were under pressure to move towards sustainable development (Šević et al., 2024). Therefore, there was a need to create indicators that would allow the assessment of environmental, social and governance (ESG), which became not only a standard for assessing the overall level of sustainable development of a company, but also an important factor in green financing, becoming a strategy that influences corporate decisions and builds the company's reputation (Wan et al., 2023).

Jiang et al. (2022) note that the proliferation of ESG has contributed to the transition of companies from exclusively maximising their own interests to maximising social value. This process reflects the increasing importance of sustainability in corporate strategies, as companies begin to consider not only economic, but also social and environmental aspects. However, as research confirms, the interest of investors in socially responsible investments plays an important role, so that companies are interested in implementing sustainable practices not only for ethical reasons but also for financial rewards (Kilic et al., 2022). In their work, De Souza Barbosa et al. (2023) posit that, rather than considering ESG criteria separately, they should be integrated into financial analysis. This approach would facilitate a more comprehensive assessment of potential risks and opportunities, attract investments, and enable companies to enhance their reputation and fortify their competitive positions in the market.

The present study explores the relevance of the research topic in the context of mounting pressure on companies to implement environmental, social and governance (ESG) practices, as well as the growing role of green indices. These indices have become important not only for ethical business conduct, but also for attracting investment and scaling up entrepreneurial activity.

The aim of the study is to analyse green indices in ensuring sustainable development, as well as their role in attracting investment and their impact, in the context of a green economy, on the creation of new jobs in the renewable energy sector.

To achieve this goal, the following research objectives were identified:

– To analyse the current state of scientific research in the field of ESG and green indices;

– to study the main types and characteristics of green indices and their role in ensuring sustainable development;

– to identify trends in sustainable investment;

– to assess the impact of the green economy on job creation in the renewable energy sector.

Throughout the research process, a range of general scientific and specialised methods are used, including bibliometric methods to analyse the publication activity of ESG research in the Scopus database; cluster analysis to identify relationships between different areas of ESG research; comparative methods to analyse different types of green indices and to provide their characteristics; statistical analysis of data on job creation in the renewable energy sector. The amalgamation of these methodologies engenders the capacity to undertake a meticulous examination and formulate substantiated scientific conclusions. The pioneering nature of this research is predicated on the integration of ESG indicators into financial analysis, thereby enabling the evaluation of not only economic but also social and environmental dimensions of companies' operations. In this context, particular attention should be paid to the role of green indices, which serve as a guide for investors, stimulate companies to implement sustainable practices and positively affect the creation of new jobs in the renewable energy sector. This allows for the assessment of the practical impact of ESG criteria on the transformation of the global labour market and the development of a green economy.

2 Analysis of Recent Research and Publications

The number of scientific articles devoted to ESG is growing rapidly; however, there is still no clear academic definition of this concept (Wan et al., 2023). Bibliographic analyses conducted in recent years have indicated a surge in the popularity of this subject since the 2010s, with publications from 2014–2015 being the most cited and influential, thereby underscoring the significance of ESG as an integrated framework for sustainable development analysis (Gao et al., 2021; Wan et al., 2023). In order to test this hypothesis, a search was conducted for scientific publications in the Scopus database using the "ESG" (Environmental, Social, Governance) criterion. The database yielded a total of 13,567 documents that contained the term "ESG" in their respective article titles, abstracts, or keywords (Scopus, n.d.). The dynamics of

publications show that the peak of activity occurred in 2012–2013, after which there was a gradual decrease in the number of publications. Since 2018, there has been a resurgence of interest in the subject of ESG, which resulted in a significant increase in publications in 2024. To facilitate a more precise analysis, the study was limited to the time frame from 2000 to 2025 and focused on the economic direction of publications.

According to the results, the largest number of scientific works (5,689 documents) concerns the economic sphere and such industries as business, management and accounting (3,905 publications); economics, econometrics and finance (3,816 publications) (Scopus, n.d.). In terms of geographical distribution, scientific research on ESG topics is most active in China – 1,146 publications, the United States of America – 837, the United Kingdom – 557, Italy – 449 and India – 439 publications (Scopus, n.d.). It is worth noting the activity of Ukraine, where 38 scientific works were recorded according to the ESG criterion.

A cluster analysis was conducted on the basis of the aforementioned parameters and a selection of scientific papers. This analysis demonstrated that the primary areas of ESG research can be divided into four groups: social responsibility, financial sustainability, innovation, and management aspects (see Figure 1).

The figure shows four coloured clusters, where the size of each bubble reflects the frequency of the terms mentioned in the survey, and their location demonstrates the interrelationships between ESG factors:

1. The green cluster is dedicated to the subjects of corporate governance, environmental responsibility, sustainable development and the social responsibility of companies.
2. The blue cluster focuses on sustainable finance, responsible investing, green bonds and the assessment of ESG risks for financial markets.
3. The red cluster is characterised by an emphasis on green innovation, economic growth, the impact of ESG on the economy and financial performance.
4. The yellow cluster demonstrates research related to global governance, social responsibility, stakeholder engagement and the impact of ESG on developing countries.

The issue of sustainable development is of paramount importance to the modern economy, and as such, particular attention is paid to the environmental responsibility of companies using green indices that reflect the level of environmental, social and corporate responsibility. It is evident that the second cluster (blue) underscores the pivotal role of financial markets and corporations in the execution of ESG criteria through the medium of responsible investing. This process entails the

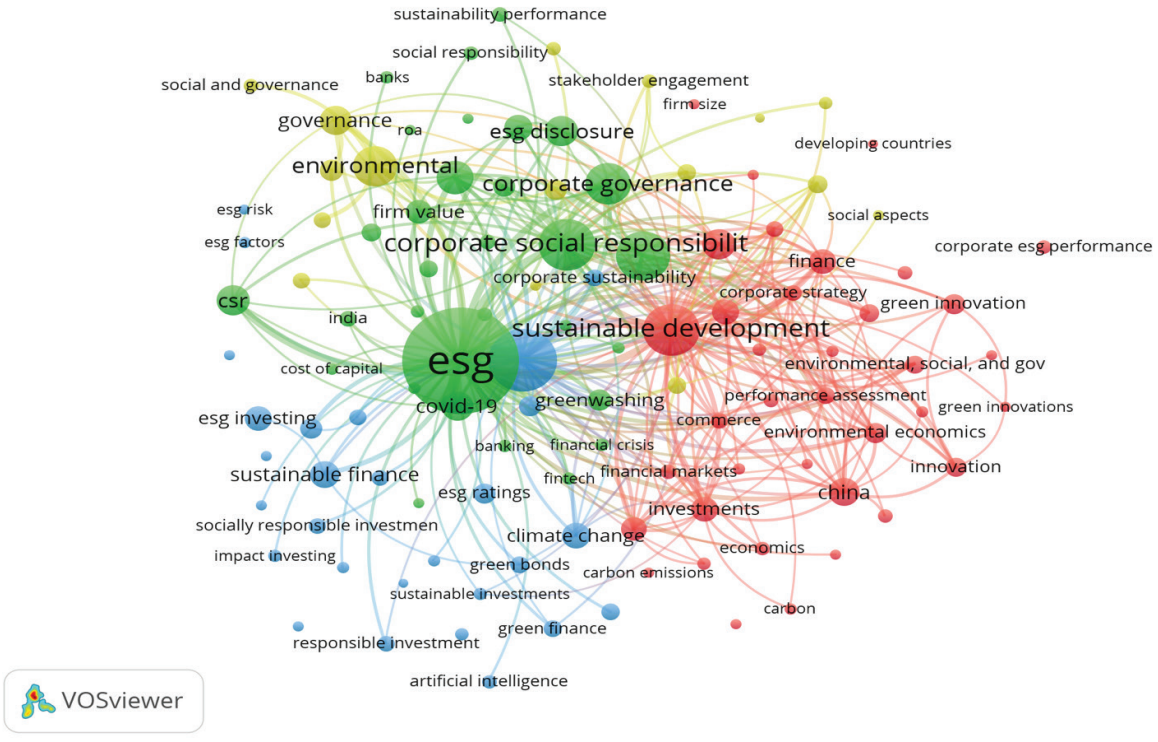

Figure 1 Map of relationships of scientific research in the field of ESG

Source: created by the authors based on the Scopus database

utilisation of green indices, which function as a benchmark for investors seeking to allocate capital towards sustainable and transparent initiatives that are conducive to the realisation of global sustainable development objectives. Concurrently, the green cluster assumes significance within the context of pertinent indices due to its emphasis on corporate governance, social responsibility, and environmental reporting of companies. The data obtained as a result of the implementation of transparent corporate governance practices serves as the foundation for the development of ESG criteria and ensures their reliability.

3 Functioning of Green Indices in Sustainable Development

The historical evolution of socially responsible investment instruments corroborates the mounting significance of green indices in contemporary financial markets. According to MSCI Inc. (2020), in 1990, KLD Research & Analytics launched the first socially responsible investment index, the Domini 400 Social Index (now the MSCI KLD 400 Social Index), which reflects the sustainability of a company (excluding those whose activities are related to industries such as tobacco and weapons) by analysing areas such as the environment, community and society, employees and supply chain, customers, governance and ethics (KLD Research & Analytics Inc., 2007). Three decades later, in 2020, MSCI Inc. had already developed more than 1,500 ESG indices for equities and fixed income (2020). By the present day, this figure has increased even further. The following table sets out several of the main green indices and their characteristics (Table 1).

Green indices provide companies with not only reputational benefits, but also easier access to financial resources. The role of green indices is described in more detail in the table below (Table 2).

The table illustrates the role of green indices in sustainable development, their influence on companies, investors, governments and society, and their function as a powerful tool for transforming the economy towards environmental sustainability. Furthermore, it ensures the transparency of companies' activities and attracts investments to sustainable projects.

4 Sustainable Investment Trends

In the contemporary business landscape, sustainability has emerged as a pivotal strategic asset, enabling enterprises to garner heightened investment. Consequently, green indices have become an integral component of the investment process, and there has been a notable rise in the reporting of ESG elements, as evidenced by the fact that over 90% of S&P 500 companies and approximately 70% of Russell 1000 companies publish ESG reports (Pérez et al., 2022). Transparency and clear reporting are of crucial importance in ensuring ESG compliance, given the repercussions for the ability to attract investors. As of the end of 2022, the total amount of assets held in ESG-related funds was approximately 30 trillion USD. According to Bloomberg forecasts, this figure is projected to exceed 40 trillion USD by 2030 (Bloomberg Finance L.P., 2024). Consequently, sustainable investing, which until recently was popular only among socially responsible investors, has now become the main factor affecting changes in financial markets.

In total, sustainable investment assets will amount to 22,838 billion USD in 2016, 30,683 billion USD in 2018, a further 15% increase to 35,301 billion USD in 2020, and 30,321 billion USD in 2022, excluding the US due to a change in calculation methodology (Global Sustainable Investment Alliance, 2023, p. 10). The analysis of regional data on global sustainable investment assets for the period 2016–2022 also demonstrates a significant increase in interest in companies that adhere to ESG principles (Figure 2).

The figure indicates that the European region has sustained its position as a leader throughout the period under analysis, achieving a peak of 14,075 billion USD in 2018. Europe has implemented a series of stringent environmental regulatory measures that not only encourage companies to pursue sustainable development but also ensure compliance with the requirements of the Green Deal, thereby attracting a substantial volume of sustainable investment. In addition, the regulatory framework plays an important role; for example, the European Union has introduced several measures in recent years, including the Sustainable Finance Disclosure Regulation (SFDR), which provides transparency for financial market participants and allows investors to make informed decisions, taking into account all risks (European Commission, 2023). In this manner, Europe is seeking to attract private capital for the transition to a zero-waste economy, with the development of ESG principles and the creation of competitive and sustainable development.

The most significant surge in investment assets was witnessed in Japan from 2016 to 2022, with an increase of 804.85%, signifying the nation's proactive engagement in sustainable investment amidst the presence of promising projects. Notably, Japan places considerable emphasis

Table 1 Green indices and their characteristics

Index	Year of establishment	Characteristics
Dow Jones Sustainability Index (DJSI) (S&P Global, n.d.)	1999	One of the first ESG indices. Evaluates companies based on environmental, social and governance criteria. Contains more than 20 criteria, including carbon reduction strategies, environmental innovation, and transparency of reporting.
FTSE4Good Index (FTSE Russell, 2024)	2001	Designed to evaluate companies with high standards of environmental responsibility and social governance, the index includes several separate stock indices, each tailored to a specific geographic region: USA, UK, Japan, Malaysia and others.
FTSE Environmental Technology Index Series (FTSE Russell, 2024b)	–	A series of indices (FTSE ET50, FTSE ET100) that measure the performance of companies engaged in the development and implementation of environmental technologies in the energy, water, waste and agribusiness sectors and have at least 50% of their revenues from environmental products and services. The FTSE ET50 and FTSE ET100 indices comprise the 50 and 100 largest pure-play companies by market capitalisation.
MSCI Global Green Building Index (MSCI Inc., n.d.)	2010	Covers large, medium and small companies from developed and emerging markets that derive 50% or more of their revenues from green building.
MSCI ESG Leaders Index (MSCI Inc, 2024)	2007	The index is adjusted for market capitalisation and aims to reflect the performance of companies in complying with environmental, social and governance (ESG) principles.
Global Green Finance Index (Z/Yen Group Limited, n.d.)	2018	An index that assesses the competitiveness of financial centres (Paris, New York, Shanghai, etc.) in green finance. It analyses how different cities and regions support the development of green investments and financial services, particularly in the context of sustainable development and environmental initiatives.
Carbon Disclosure Project Scores (CDP) (Carbon Disclosure Project, n.d.)	2000	A non-profit charity that assesses companies' disclosure of carbon emissions, climate change strategies and resource management for investors, companies, cities, states and regions to manage their environmental impact.
Green Bond Index (GBI) (Solactive AG, n.d.)	2014	Measures the yield and growth of green bonds that finance environmentally sustainable development.
Diversity and Inclusion Index (FTSE Diversity and Inclusion Index, 2024)	2009	Focuses on inclusiveness and diversity, but also takes into account elements of environmental impact. The index analyses policy transparency, workforce diversity, inclusion, gender equality and environmental impact reduction initiatives.
Euronext Vigeo Eiris Index (Euronext, 2017)	2012	Identifies companies that demonstrate high standards of social responsibility, including in the field of environmental protection. It is based on an assessment of more than 300 sustainability indicators, such as climate change, waste management and environmental innovation.
Sustainalytics ESG Risk Ratings (Sustainalytics, n.d.)	–	It assesses the level of risks associated with the environmental, social and governance aspects of a company's operations. The rating is based on a quantitative risk analysis of companies in 20 sectors of the economy.

Source: created by the authors

on technological innovations, particularly in the domain of renewable energy. Conversely, Canada, Australia and New Zealand demonstrate a more gradual positive trend in the growth of sustainable investment assets.

As a result, sustainable investment has become a driver of economic growth, not just about environmental and social responsibility, but about building a sustainable, competitive economy. Integrating ESG factors into investment decisions

Table 2 The role of green indices in sustainable development

Role	Description	Example
Reputation	Encourage companies to implement environmental practices and standards to gain a green reputation.	For example, companies in the FTSE4Good index have changed their governance policies to meet sustainability criteria.
Investment attraction	Green indices serve as a benchmark for investors seeking to invest in environmentally responsible companies.	In 2022, more than 30 trillion USD of global investment was directed to companies with high ESG ratings (Global Sustainable Investment Alliance, 2023, p. 10).
Transparency and accountability	Promote transparency of companies' environmental activities by disclosing data on waste emissions, resource management, etc.	The Carbon Disclosure Project (CDP) reports provide detailed information on the climate impact of companies.
Influence on public policy	They support the creation of legislative initiatives that promote sustainable development.	The EU uses green indices to assess the effectiveness of the Green Deal.
Support for sustainable technologies	They help find companies investing in renewable energy and innovative technologies.	The FTSE Environmental Technology Index supports companies working in the field of energy efficiency.
Stimulation of market growth	To promote the market capitalisation of sustainable companies through the interest of investors and society in environmental responsibility.	The MSCI ESG Leaders Index has seen an increase in market capitalisation of more than 20% over the past year (MSCI Inc., 2024).
Creation of additional jobs	The green economy provides employment opportunities in sustainable sectors of the economy, such as renewable energy, environmental monitoring, and waste management.	In 2023, green energy created 13.7 million jobs worldwide (International Renewable Energy Agency, n.d.).
Education and public awareness	Promoting environmental values among the population, encouraging a more responsible attitude to exhaustible resources.	Information campaigns related to ESG ratings help raise environmental awareness in society.

Source: created by the authors

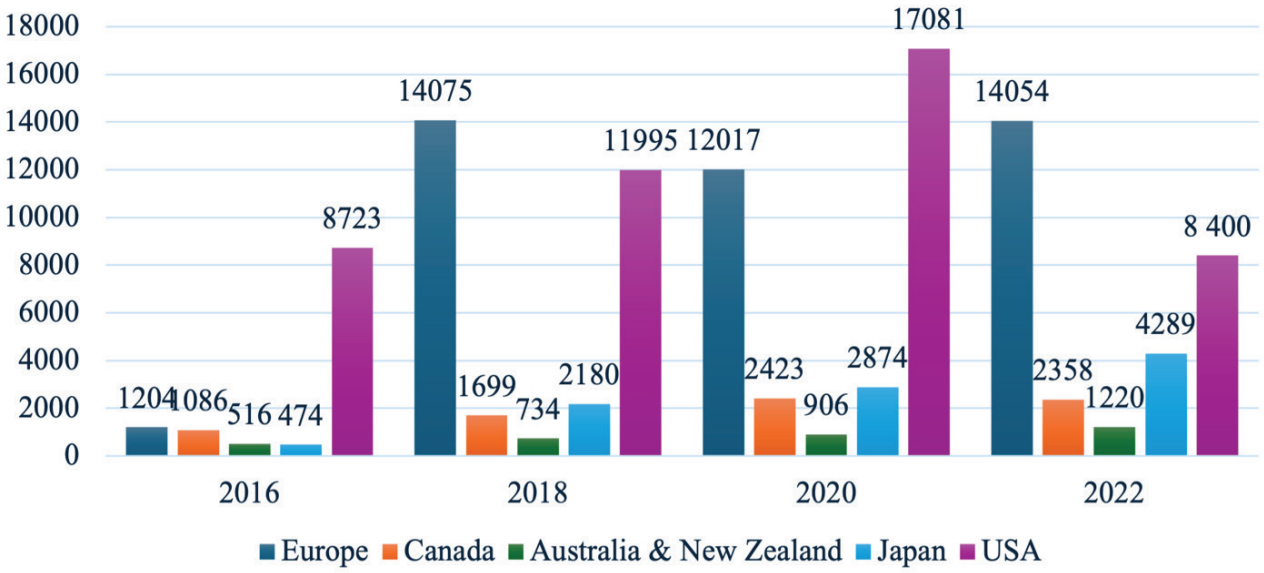

Figure 2 Global sustainable investing assets, 2016–2022, billions USD

Source: created by the authors on the basis of Global Sustainable Investment Alliance, 2023, p. 10

not only minimises risk, but also stimulates innovation and opens up new business opportunities. With regulatory support and growing investor demand, sustainable development is becoming an important factor in improving the quality of life.

5 The Impact of the Green Economy on Employment

In 2012, at the United Nations Conference on Sustainable Development in Rio de Janeiro, the green economy was identified as a primary means of achieving sustainable development and overcoming poverty. The conference saw particular emphasis placed on the promotion of sustainable, equitable economic growth and the enhancement of employment opportunities, with a particular focus on young people, women, and economically disadvantaged populations (United Nations, 2012). A year later, at the International Labour Conference on Sustainable Development, Decent Work and Green Jobs, it was emphasised that the transition to environmental sustainability can be a significant impetus for job creation, which in turn is an integral part of the green transition (International Labor Office, 2013). The advantages of a green economy and sustainable investments are manifold. In addition to the promotion of decarbonisation and compliance with the objectives of sustainable development, they also include the creation of new jobs, which has a positive effect on the reduction of unemployment, sustainable global economic growth and the quality of life of society.

According to a report by the International Renewable Energy Agency (IRENA) and the International Labour Organisation (ILO), in 2023 the world saw a record increase of 18.2% year-on-year in the number of jobs in the renewable energy sector to 16.2 million, as detailed in Figure 3 (IRENA and ILO, 2024).

China is the largest employer in the field of renewable energy, providing 7.4 million jobs, representing 46% of the total global figure. The European Union (1.8 million jobs), Brazil (1.6 million), and the United States and India (over 1 million each) also account for a significant share of jobs (IRENA and ILO, 2024) (Table 3).

China has assumed a leading global role in the production of solar and wind energy equipment, with large-scale manufacturing generating millions of employment opportunities. LONGi Solar, a preeminent player in the global solar technology sector, has demonstrated a notable commitment to promoting a transition towards ecological and sustainable development. In addition to its presence in China, the company has a global workforce spanning six continents, including Asia, North America and Europe. LONGi allocates substantial resources to the advancement of innovative solar energy technologies, thereby contributing to the generation of green employment opportunities. As of

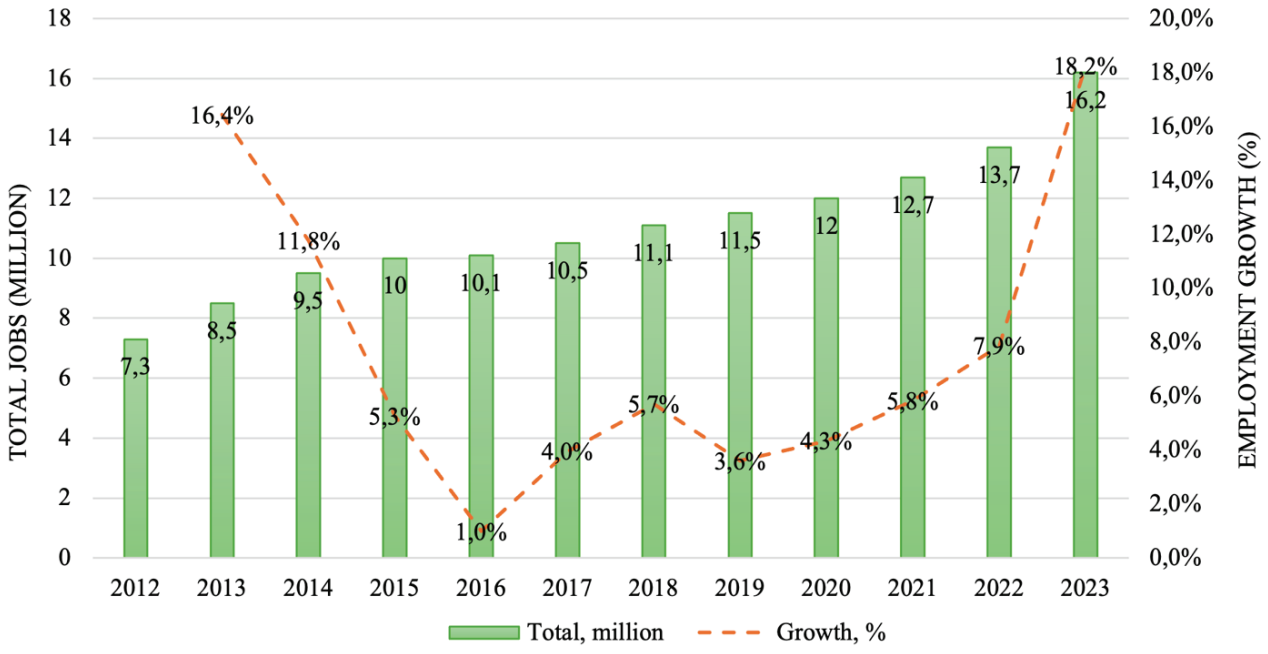

Figure 3 Total number of jobs in renewable energy, 2012–2023, million jobs

Source: created by the authors on the basis of IRENA and ILO, 2024

Table 3 Number of jobs in renewable energy by technology, 2012–2023, million jobs

Year	Solar photovoltaic	Bioenergy	Hydropower	Wind energy	Solar heating / cooling	Others
2012	1,36	2,4	1,66	0,75	0,89	0,22
2013	2,27	2,5	2,21	0,83	0,5	0,23
2014	2,49	2,99	2,04	1,03	0,76	0,19
2015	2,77	2,88	2,16	1,08	0,94	0,2
2016	3,09	2,74	2,06	1,16	0,83	0,24
2017	3,37	3,05	1,99	1,15	0,81	0,16
2018	3,68	3,18	2,05	1,16	0,8	0,18
2019	3,75	3,58	1,96	1,17	0,82	0,18
2020	3,98	3,52	2,18	1,25	0,82	0,25
2021	4,29	3,44	2,37	1,37	0,77	0,43
2022	4,9	3,58	2,49	1,4	0,71	0,64
2023	7,11	3,88	2,32	1,46	0,68	0,78

Source: created by the authors on the basis of IRENA and ILO, 2024

2024, the company's global workforce is estimated to comprise approximately 10,000 individuals (LeadIQ Inc., n.d.). Similarly, Goldwind, a prominent Chinese manufacturer of wind turbines, operates in 42 countries across six continents and has established eight scientific centres worldwide, employing approximately 10,000 individuals, including over 3,000 researchers, developers and technical staff. Evidence suggests that both Chinese companies demonstrate a commitment to ESG criteria, and are regularly included in the ratings of green indices. According to the MSCI ESG index, the companies received a BBB rating in 2024, indicating an average level of environmental, social and governance performance (Goldwind, n.d.; LeadIQ Inc., n.d.).

In the European Union, wind energy maintains a competitive position and exhibits a high level of innovation, state subsidies for the development of "green" energy, and a commitment to achieve climate neutrality by 2050. However, it is gradually losing ground to China due to higher production costs.

The technology breakdown demonstrates that solar energy (photovoltaics) remains the leading sector, with 7.1 million jobs, accounting for 44% of all renewable energy employment. In hydropower, there has been a decline in the initiation of new projects (2.3 million jobs, representing a 4% decrease compared to 2022), particularly in developed countries, due to the environmental and social risks associated with the construction of large dams. Bioenergy accounts for 2.8 million jobs, most of which are in agriculture, mainly in Brazil (994,000 jobs) and Indonesia (798,000 jobs) (IRENA and ILO, 2024). Biofuels are a key sector in countries rich in agricultural resources. In Brazil, the main source is sugar cane, which is used to produce ethanol. Indonesia is a leading producer of palm oil, which is actively used in biofuels.

The green transformation of the economy has a considerable impact on the labour market. Indeed, there is already a proliferation of new jobs in the renewable energy sector worldwide. Concurrently, the green transition is conducive to environmental preservation and ensures economic growth and development of the national economies of the world.

6 Conclusions

The present study thus confirms the growing role of ESG criteria and green indices in the modern economy. Since the adoption of the United Nations Sustainable Development Goals in 2015, there has been a significant increase in attention to the environmental, social and governance aspects of companies' activities. This is reflected in the rapid growth of the number of scientific publications on ESG topics and the expansion of the number of green indices that assess the sustainable development of businesses. The role of ESG criteria has become not just important but fundamental in the modern economy, having evolved from a concept focused on individual investors to a global financial market standard.

It is evident that one of the most significant instruments in the integration of ESG into practice is the green indices created by leading global organisations. These indices play a pivotal role in the stimulation of sustainable development and transformation of the global economy. Moreover, they serve as a tool for the assessment of the environmental, social and corporate responsibility of companies. This contributes to the transparency of their activities, attracts investments and improves

their reputation. The indices take into account many indicators, including financial, environmental, innovation, and energy, and serve as an impetus for companies to adapt their strategies to the urgent needs of sustainable development. It has become important for the business sector to be included in the index ratings, and there is a need to review its activities and business processes, introduce innovations and new approaches, which, in turn, opens up opportunities for growth and further development.

The incorporation of green indices into corporate financial strategies has been demonstrated to enhance competitiveness and facilitate the adaptation of businesses to contemporary challenges associated with climate change and the transition to a green economy. The impact of these indices on job creation in the renewable energy sector merits particular attention, as this sector is poised to offer significant employment opportunities in the future. Concurrently, the green economy has been shown to facilitate the establishment of novel business models that integrate economic benefits with environmental sustainability. Countries and regions that proactively integrate ESG into their strategic frameworks have been shown to achieve superior outcomes in terms of job creation, investment attraction, and economic growth.

It is evident that ESG criteria establish novel standards for business introduction and facilitate achieving a balance between economic efficiency and environmental protection and social welfare. The further development and utilisation of green indices represents not only an opportunity for businesses to adapt to new requirements, but also a powerful tool for transforming the economic system into a more sustainable and innovative structure that opens prospects for economic growth.

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