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SUSTAINABLE ENTREPRENEURSHIP IN CENTRAL AND EASTERN EUROPE: A COMPARATIVE ANALYSIS OF DEVELOPMENT DYNAMICS (2008-2024)

Magdalena KOWALSKA

Faculty of Economics and Sociology, University of Lodz; magdalena.kowalska@uni.lodz.pl,
ORCID: 0000-0002-5821-0305

Purpose: This study aims to assess the level and dynamics of sustainable entrepreneurship (SusE) and its three pillars – economic (EcoE), social (SocE), and environmental (EnvE) – in selected economies of the Central and Eastern European region. The study also aims to identify long-term changes that occurred during the analysed period and to determine differences between individual countries in the implementation of the concept of sustainable enterprise development.
Design/methodology/approach: The research methodology is based on quantitative comparative analysis using data for eleven Central and Eastern European countries from 2008 to 2024. The study constructed a synthetic index of sustainable entrepreneurship, aggregating three pillars: economic, social, and environmental, based on standardised data from the Eurostat database. Descriptive statistics, linear trends, and dynamics of change were calculated. This approach enabled an assessment of the level, stability, and direction of sustainable entrepreneurship development in both a long-term and comparative perspective.
Findings: The research results indicate a systematic increase in the level of sustainable entrepreneurship in all analysed countries between 2008 and 2024. Significant variation in the SusE was found between countries in the region, with Czechia, Poland, Slovakia, Hungary, and Slovenia leading the way. The environmental pillar exhibited the highest growth dynamics. The social pillar was the most stable. Countries with lower starting levels demonstrated a relatively faster growth rate, confirming the convergence process and the mutual reinforcement effect between pillars.
Research limitations/implications: The study is limited by the macroeconomic level of analysis and the selection and aggregation of variables into a synthetic indicator. Future research could include sectoral or microeconomic analyses, as well as the identification of institutional and technological determinants.
Practical implications: The results can provide a basis for formulating integrated public policies that support sustainable entrepreneurship in the region.
Social implications: The study emphasises the significance of sustainable entrepreneurship in enhancing the quality of life, preserving the environment, and promoting social cohesion.
Originality/value: This paper adds value through a long-term, multidimensional analysis of sustainable entrepreneurship in Central and Eastern Europe using a synthetic indicator.
Keywords: sustainable entrepreneurship; Central and Eastern Europe; synthetic indicator; development dynamics.
Category of the paper: research paper.

1. Introduction

Over the past two decades, the concept of sustainable development has become one of the key paradigms defining the directions of economic, social, and environmental change. Sustainable entrepreneurship, as an extension of the classic idea of entrepreneurship, combines three key dimensions - economic, social, and environmental - enabling value creation in a way that does not limit future development opportunities. The theoretical section of the article emphasises that sustainable entrepreneurship goes beyond the traditional perspective of profit and efficiency, integrating the assumptions of the Triple Bottom Line, the circular economy, socially responsible entrepreneurship, and green innovation. Contemporary literature emphasises its holistic nature and the need to treat it as a process that encompasses the simultaneous creation of economic value, social capital, and a positive ecological impact.

The importance of sustainable entrepreneurship is particularly important in the countries of Central and Eastern Europe, which have undergone dynamic economic, institutional, and social transformations since 2004. These processes, including the modernisation of economic structures, strengthening innovation potential, and the implementation of EU environmental regulations, create unique conditions for analysing sustainable entrepreneurship from a comparative perspective. However, this region remains diverse in terms of the pace of adoption of sustainable development principles, the level of human capital, the quality of institutions, and the implementation of environmental policies. Despite growing academic interest in research in this part of Europe, there is still a lack of studies that approach sustainable entrepreneurship holistically, combining the three pillars in a coherent analytical model and examining their interdependencies.

To address this gap, this article presents an empirical assessment of the level and dynamics of sustainable entrepreneurship in eleven Central and Eastern European countries between 2008 and 2024. This study aims to assess the level and dynamics of sustainable entrepreneurship, as well as its three pillars – economic, social, and environmental – in selected regional economies, and to identify long-term changes and differences between countries. The study utilises a multidimensional synthetic indicator of sustainable entrepreneurship (SusE), built on three components - economic entrepreneurship (EcoE), social entrepreneurship (SocE), and environmental entrepreneurship (EnvE). This unified index enables a holistic assessment of development, cross-country comparisons, and an analysis of the dynamics and stability of individual pillars.

The study's findings allow us to determine whether Central and Eastern European countries are evolving toward a model of entrepreneurship consistent with the concept of sustainable development, and which pillars (economic, social, and environmental) play a key role in shaping their development trajectories. This article contributes to the literature by combining a coherent theoretical framework with empirical analysis based on multi-year data. It provides

a comprehensive picture of sustainable entrepreneurship in a region that, despite its growing economic importance, remains under-researched from the perspective of integrated development indicators.

The originality of the presented material lies in its comprehensive, comparative analysis of the dynamics of sustainable entrepreneurship in Central and Eastern Europe from 2008 to 2024. The research presented in this article integrates cross-country data to examine long-term structural changes related to sustainability-oriented entrepreneurship (existing studies typically focus on a single country or a short period). The methodological approach and the scope of the dataset contribute new empirical evidence to the literature, particularly in the context of post-transition economies.

2. Literature review

The concept of sustainable entrepreneurship is rooted in entrepreneurship theory and the core principles of sustainable development. Its origins date back to the 21st century (Abbas, Bulut, 2024). In the literature, the term first appeared in the context of green or social entrepreneurship. Then, these concepts began to be integrated into the broader framework of sustainable development. The authors focus on economic, social, and environmental goals (Diepolder et al., 2021; Rosário, Figueiredo, 2024).

Sustainable entrepreneurship is a business process that fosters social and ecological development (Alkathiri et al., 2024). Cohen and Winn (2007) and Dean and McMullen (2007) indicated that entrepreneurs can contribute to reducing the negative externalities of the economy. Environmental protection should be achieved through the creation of innovative market solutions. Shepherd and Patzelt (2011) emphasised the preservation of nature, community, and life-support systems. They argued that sustainable entrepreneurship is a form of activity that strives to balance what should be developed and what should be preserved.

More recent studies (e.g., Farny, Binder, 2021; Rosário et al., 2022) emphasise that sustainable entrepreneurship links sustainable development to traditional entrepreneurship. It integrates economic, social, and ecological goals. Sustainable entrepreneurship entails entrepreneurs generating profits, also having a positive impact on nature and society (Ribeiro, Leitão, 2024). Entrepreneurs develop innovations that benefit the circular economy and improve the well-being of local communities (Kowalska, Misztal, 2023). Such entrepreneurship provides a platform for creating an innovative, inclusive, and responsible business model.

A comparison of these definitions shows that, though there is an ordinary core meaning, the priorities in the methodologies of researchers differ. While some authors focus on the value creation process (Cohen, Winn, 2007; Belz, Binder, 2017), others highlight the entrepreneur as a change agent (Shepherd, Patzelt, 2011; Farny, Binder, 2021), and others on the integration of

the three dimensions of sustainable development (economic, social, and environmental). This diversity of definition reflects the interdisciplinary nature of the phenomenon itself and its maturing development in the scientific literature.

Table 1.
Sustainable entrepreneurship - definition

Year	Author	Definition
2007	Cohen, Winn	"Sustainable entrepreneurship is the examination of how opportunities to bring into existence 'future' goods and services are discovered, created and exploited, by whom and with what economic, psychological, social and environmental consequences"
2007	Dean, McMullen	"Sustainable entrepreneurship [is] the process of discovering, evaluating, and exploiting economic opportunities that are present in market failures which detract from sustainability, including those that are environmentally relevant"
2010	Schaltegger	"Sustainable entrepreneurs introduce sustainable innovations to the market, which aim and/or effect to contribute to the solution of social or environmental problems"
2011	Shepherd, Patzelt	"Sustainable entrepreneurship is focused on the preservation of nature, life support, and community in the pursuit of perceived opportunities to bring into existence future products, processes, and services for gain, where gain is broadly construed to include economic and non-economic gains to individuals, the economy, and society"
2021	Farny, Binder	"Sustainable entrepreneurship describes the nexus between sustainable development and entrepreneurship. Entrepreneurs aspire to create viable market solutions and intend to act as change agents who realize and exploit opportunities for sustainable development"
2022	Rosário, Cruz, Pires	"In a sustainability context, entrepreneurship can be defined as the process of discovering, creating, and exploiting opportunities to produce goods and services while considering the potential environmental, social, economic, and psychological consequences"
2023	Kowalska, Misztal	"It can be defined as starting and running a business based on incorporating the goals and principles of sustainable development into the company's strategies, business models and operating style"
2024	Gutterman	"Sustainable entrepreneurship is the continuing commitment by businesses to behave ethically and contribute to economic development while improving the quality of life of the workforce, their families, the local and global community as well as future generations"

Source: own study based on the literature on the subject.

Various theoretical paradigms also mark the theory. The Triple Bottom Line philosophy (Elkington, 1997) emphasises the pursuit of economic, social, and environmental goals. Resource-based and innovation theories view sustainable entrepreneurship as achieving a competitive advantage through intangible resources. Institutional theory, in contrast, emphasises the regulatory, policy, and normative structures that encourage sustainability-oriented business practice (Atobishi, Podruzsik, 2025).

Sustainable entrepreneurship can be quantified based on three pillars that are interconnected and reflect the holistic sustainability performance of entrepreneurial activity (Diepolder et al., 2024; Bakry et al., 2022, 2024):

- The economic pillar is the ability of entrepreneurship to promote growth, innovation, and sustainable competitiveness. It records variables such as business start-up rates, high-tech jobs, productivity, and R&D expenditures. Economic success in sustainable entrepreneurship is not an end in itself, but rather a means of promoting social and environmental goals.

- The social pillar focuses on the human and social aspects of entrepreneurship. It concerns how companies contribute to social inclusion, job quality and local well-being. Sustainable entrepreneurship helps develop human capital, ethical standards, and societal harmony. Measuring this aspect is typically through indicators such as labour participation rates, equality in entrepreneurship, access to SME funding, or social innovation engagement.
- The ecological pillar examines how entrepreneurial activity impacts natural resources and ecosystems. It tracks the extent to which firms reduce pollution, responsibly generate waste, and use clean technologies. Some of the standard drivers include CO_2 intensity of emissions, the percentage of renewable energy consumed, energy efficiency, and the adoption of green innovation. The dimension reflects firms' long-term environmental accountability and contribution towards driving climate neutrality goals.

Since it is a multidimensional concept, sustainable entrepreneurship has also been evaluated using composite indices that aggregate multiple variables into a single index. Existing international measures, such as: the Global Entrepreneurship Monitor (GEM), the Global Sustainable Competitiveness Index, serve as valid benchmarking points but also fail to capture the nexus between entrepreneurship and sustainability—especially for transitioning European economies (Sulong et al., 2024; Bindeeba et al., 2025).

The construction of a Sustainable Entrepreneurship Index (SEI) involves some methodological steps (Al-Thani, Koc, 2024; Mondal et al., 2025):

- selection of indicators that proxy the three pillars (economic, social, environmental),
- normalisation of data - to ensure comparability across countries and years,
- weighting and aggregation - usually done with equal or expert-opinion-based weights,
- validation - either through correlation analysis or tests of composite reliability.

The region is undergoing a transition from an efficiency-based to an innovation-based economy, facing challenges such as limited access to green finance, resource-use-intensive lock-ins in industries, and a less established environmental consciousness (Kowalska et al., 2024; Csákné et al., 2025). Measuring sustainable entrepreneurship through a composite index enables the monitoring of these multilateral phenomena and the comparison of each country's approach toward a competitive and sustainable economy.

Although the literature on sustainable entrepreneurship has expanded significantly in recent years, most studies focus on Western European economies or analyze selected countries individually. Comparative analyses covering Central and Eastern Europe as a region, especially over a long-term perspective, remain limited. Moreover, there is a lack of studies that simultaneously examine development dynamics and sustainability-oriented entrepreneurial indicators across multiple CEE countries. According to the literature reviewed, there are no studies that comprehensively analyze sustainable entrepreneurship development in Central and Eastern Europe for the period 2008–2024. Therefore, this study addresses an important research gap and contributes to the existing body of knowledge.

3. Methods

3.1. Research objective, research problem, subject area, and research period

This study aims to assess the level and dynamics of sustainable entrepreneurship (SusE) and its three pillars – economic (EcoE), social (SocE), and environmental (EnvE) – in selected economies of the Central and Eastern European region. The study also aims to identify long-term changes that occurred during the analysed period and to determine differences between individual countries in the implementation of the concept of sustainable enterprise development.

The research question of this article is to determine the actual level and direction of sustainable entrepreneurship development in Central and Eastern European countries. Specifically, it addresses the question of whether entrepreneurship in this part of Europe is evolving towards a model consistent with the principles of sustainable development, or whether an approach focused primarily on achieving economic goals remains the dominant one. It is also important to determine whether these changes are sustainable and multidimensional in nature, and whether they are comparable across the region's economies.

The Central and Eastern European region is a particularly interesting area of research, as entrepreneurship plays an important role in the processes of economic growth and convergence with Western European countries. At the same time, these economies are characterised by a relatively short period of operation under conditions of full integration with the European Union and varying rates of implementation of social and environmental standards. It raises significant doubts about whether the development of entrepreneurship in the region is systemic and sustainable, or a selective effect limited to specific areas of economic activity.

The research area encompasses entrepreneurship analysed at the national level, understood as an element of the economic system shaped by the macroeconomic, institutional, and regulatory conditions characteristic of Central and Eastern European countries. This approach allows us to view sustainable entrepreneurship not only through the lens of individual economic entities but also as a phenomenon with broad developmental implications.

The 2008-2024 research period was chosen due to:

1. The availability of comprehensive, comparable Eurostat data since 2008 (this year saw the harmonisation of many structural indicators, allowing for the consistent construction of economic, social, and environmental indicators).
2. The significance of 2008 as the beginning of the global financial crisis provides a starting point for analysing the resilience, flexibility, and adaptability of enterprises in the region.
3. The period of intensive adaptation of Central and Eastern European economies to EU policies (including climate packages and sustainable development strategies - Europe 2020, Fit for 55, European Green Deal).

4. The availability of data until 2024, which allows for the capture of the latest trends in the development of sustainable entrepreneurship, including post-COVID-19 and under current economic and regulatory changes.

It allows the research period to encompass both the years of macroeconomic shocks and the phases of stabilisation and acceleration of the transformation towards a sustainable economy.

The literature on the subject is dominated by studies that analyse individual dimensions of entrepreneurship separately - economic, social, or environmental. However, comprehensive analyses integrating these three pillars into a single, synthetic indicator are lacking, particularly in Central and Eastern European countries. This study fills this research gap by constructing and applying a composite indicator of sustainable entrepreneurship, enabling the assessment of the level and dynamics of this phenomenon in a comparative and long-term perspective.

The issues discussed are significant from both the theoretical and practical perspectives of economics. From a theoretical perspective, the study contributes to the development of the concept of sustainable entrepreneurship through its operationalisation and empirical verification in a macroeconomic context. In turn, from an applied perspective, the obtained results provide valuable information for public decision-makers, entrepreneurship support institutions, and entrepreneurs, providing a basis for designing and evaluating policies and instruments that foster sustainable economic development.

3.2. Research hypotheses

Based on the literature review and the adopted research concept, one main hypothesis (H0) and five specific hypotheses (H1, H2, H3, H4, H5) were formulated.

The main hypothesis (H0) is that *between 2008 and 2024, there was a systematic increase in the level of sustainable entrepreneurship in Central and Eastern European countries, resulting from the simultaneous improvement of economic, social, and environmental pillars*. Its justification lies in the fact that sustainable entrepreneurship is emerging in conditions of simultaneous growth in economic efficiency, social capital quality, and environmental responsibility. The coherence of public policies, the growing role of EU regulations, and the increased level of socio-economic development support the simultaneous improvement of all three pillars.

The first specific hypothesis (H1) is that *the level of sustainable entrepreneurship in Central and Eastern European countries varies significantly between countries*. It stems from institutional, developmental, technological, and social differences. The countries studied differ in terms of governance quality, economic structure, and degree of implementation of EU policies. These different conditions result in significant differences in the level of all three pillars of entrepreneurship.

The second specific hypothesis (H2) is that *the dynamics of change in the environmental pillar were higher than in the economic and social pillars during the analysed period*. The environmental pillar is strongly stimulated by EU directives, restrictive climate regulations,

and investment support (ETS, Fit for 55). As a result, enterprises adapt more quickly ecologically than economically or socially.

The third specific hypothesis (H3) is that *the greatest stability of changes over time characterises the social pillar of sustainable entrepreneurship*. Human capital, job quality, and the level of social security change gradually. Labour market policies and social institutions are stable and long-term, limiting fluctuations.

The fourth specific hypothesis (H4) is that *the countries with lower initial levels of sustainable entrepreneurship showed a relatively higher rate of growth in this indicator between 2008 and 2024*. According to the convergence theory, less developed economies grow faster. They can easily adapt existing solutions and catch up institutionally. Growth dynamics are relatively higher in these areas.

The fifth specific hypothesis (H5) is that *the changes in the economic, social, and environmental pillars mutually reinforce each other, creating a systemic effect*. The economic pillar supports social and environmental investments, and stable social and ecological conditions increase economic efficiency. A co-reinforcing system is created, in which improvement in one pillar supports the development of the others.

3.3. Research stages

The study was conducted in four main stages. Indicators were created, and simplifications were applied due to the lack of a uniform international indicator of sustainable entrepreneurship. Data are sourced entirely from Eurostat, ensuring methodological consistency and comparability across countries and over time.

1. Stage 1 of the study - variable selection and normalisation.

In the first stage, analytical variables comprising the three pillars of sustainable entrepreneurship: economic, social, and environmental were selected and normalised. Min-max normalisation was applied, transforming the variables to a range of 0-1, enabling comparability across time and across countries. The analysis covered eleven Central and Eastern European countries from 2008 to 2024 – Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovakia, and Slovenia.

The economic entrepreneurship indicator is a synthetic measure that describes the level and dynamics of enterprise activity, encompassing: quantitative, production, and investment dimensions. It was constructed based on the following variables:

- number of enterprises,
- value of global production,
- total purchases of goods and services,
- investment rate of the enterprise sector.

The selection of variables was based on the assumptions of economic growth theory, entrepreneurship theory, and structural economics, which suggest that entrepreneurship is a process of creating added value, accumulating capital, and transforming resources into productive and innovative activities. Combining these variables enables the conceptualisation of entrepreneurship in quantitative, economic, and dynamic dimensions.

The social entrepreneurship indicator reflects the social impact of enterprise operations, encompassing employment quality and labour productivity. The index is based on the following variables:

- personnel costs,
- wage levels,
- social security costs,
- number of employees,
- labour productivity,
- gross value added per employee.

The selection of indicators is consistent with: human capital theory, labour economics, and the concept of inclusive growth, according to which the development of entrepreneurship should contribute not only to increased production but also to improved working conditions, employment stability, and the efficient use of labour resources.

The environmental entrepreneurship indicator describes the impact of enterprises on the natural environment, based on the level of pollutant emissions. The following variables were used to construct the index:

- CO_2 emissions,
- methane (CH_4) emissions,
- nitrous oxide (N_2 O) emissions,
- sulfur oxide (SO_2) emissions,
- nitrogen oxide (NOx) emissions,
- ammonia (NH_3) emissions.

The variables were selected in consideration of the assumptions of environmental economics and the theory of internalising external costs. The emissions approach is commonly used as a measure of environmental burden and simultaneously allows for the comparison of enterprises' environmental performance across time and space.

2. *Stage 2 of the study - construction of pillar indicators - EcoE, SocE, EnvE.*

In the second stage, synthetic indicators of economic, social, and environmental entrepreneurship were developed. An equal-weighted aggregation method was used due to the lack of empirical evidence to differentiate the significance of individual variables and the need to maintain comparability across countries and years. For each pillar, the following were calculated:

- descriptive statistics (mean, median, SD, min, max),
- trend line with coefficient of determination:

$$EcoE = \alpha_0 + \alpha_1 \cdot time + \varepsilon,$$
$$SocE = \alpha_0 + \alpha_1 \cdot time + \varepsilon, \quad (1)$$
$$EnvE = \alpha_0 + \alpha_1 \cdot time + \varepsilon.$$

The interpretation of R^2:

- 0-0.5 - satisfactory,
- 0.5-0.6 - poor,
- 0.6-0.8 - satisfactory,
- 0.8-0.9 good,
- 0.9-1.0 very good.

3. *Stage 3 of the study - construction of a synthetic indicator of sustainable entrepreneurship (SusE).*

$$SusE = EcoE + SocE + EnvE \quad (2)$$

The following were calculated:

- descriptive statistics (mean, median, SD, min, max),
- trend line with the coefficient of determination (according to the previously adopted scale).

This procedure allowed for the assessment of both the level and dynamics of sustainable entrepreneurship development in Central and Eastern European countries from 2008 to 2024.

4. *Stage 4 of the study - a sustainable entrepreneurship ranking for Central and Eastern European countries.*

In the final, fourth stage of the study, a ranking of Central and Eastern European countries was created based on average SusE values, which enabled the identification of leaders and countries with lower levels of the sustainable entrepreneurship index. The ranking is synthetic in nature and encompasses the full cross-section of the years studied, enabling the assessment of each country's long-term position.

4. Results

Table 2 presents synthetic indicators of economic, social, and environmental entrepreneurship in Central and Eastern European countries in 2008-2024 (EcoE, SocE, EnvE – the three pillars of the synthetic indicator of sustainable entrepreneurship in Central and Eastern European countries in 2008-2024 – SusE). Their values range from 0 to 1 – the higher the indicator level, the higher the level of development of a given pillar of sustainable entrepreneurship.

The economic entrepreneurship indicator in Central and Eastern European countries from 2008-2024 is a synthetic measure of the activity and development potential of the business sector, integrating information on the scale of companies' operations, their production results, market connections, and propensity to invest.

A systematic increase in the EcoE is observed in all analysed countries between 2008 and 2024, with a particularly pronounced acceleration observed after 2013. This trend may indicate:

- improved economic efficiency of the enterprise sector, manifested by an increase in the scale and results of production activities,
- increased capital expenditures, including investments in modern technologies and innovation,
- increased resilience of enterprises to economic fluctuations and macroeconomic shocks,
- gradual stabilisation of business conditions, favouring long-term development planning.

Countries such as the Czechia, Poland, and Estonia achieve the highest and most stable EcoE values, indicating a strong foundation for the development of sustainable entrepreneurship.

The social entrepreneurship indicator in Central and Eastern European countries from 2008 to 2024 is a synthetic measure that describes the level and dynamics of the social impact of enterprises on the economy, measured in terms of employment, working conditions, and labour productivity.

Table 2 shows a clear and systematic increase in the SocE in all countries. This trend may indicate:

- improved working conditions and wage levels, reflected in rising personnel costs and social security benefits,
- increased quality of human capital and the efficiency of its utilisation, reflected in increased labour productivity and gross value added per employee,
- the growing importance of employment as a component of enterprise development strategies, measured by changes in the number of employees,
- the gradual strengthening of the social dimension of economic development, including greater labour market inclusiveness and stabilisation of employer-employee relations.

The highest SocE values are in Slovenia, the Czechia, and Estonia, indicating a very high level of social development in the context of entrepreneurship.

The environmental entrepreneurship indicator in Central and Eastern European countries from 2008 to 2024 is a synthetic measure that assesses the environmental impact of business activity, taking into account greenhouse gas and air pollutant emissions. It allows for comparisons of the environmental performance of the business sector nationally and over time.

Table 2 shows an increase in EnvE in all countries (especially after 2015). This trend may indicate:

- improved environmental performance of businesses, manifested by reduced greenhouse gas and air pollutant emissions,
- the growing importance of environmental protection policies and sustainability standards in business operations,
- the implementation of modern technologies and pro-environmental practices in production,
- the increasing resilience of the business sector to regulatory and social pressures related to environmental protection.

Countries such as the Czechia, Slovakia, Slovenia, and Romania have achieved values close to 1.00 in recent years, indicating a very high level of environmental target achievement.

Table 2.
Synthetic indicators of economic, social and environmental entrepreneurship, Central and Eastern European countries (2008-2024)

Country	Synthetic indicator (pillars of SusE)	Year																
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Bulgaria	EcoE	0.77	0.71	0.64	0.69	0.72	0.7	0.73	0.74	0.73	0.77	0.81	0.85	0.84	0.83	0.84	0.84	0.85
	SocE	0.63	0.61	0.61	0.63	0.63	0.64	0.66	0.7	0.72	0.77	0.81	0.87	0.89	0.88	0.88	0.89	0.9
	EnvE	0.66	0.71	0.69	0.64	0.68	0.79	0.74	0.72	0.76	0.76	0.79	0.83	0.87	0.86	0.87	0.87	0.88
Croatia	EcoE	0.97	0.89	0.76	0.73	0.71	0.71	0.7	0.75	0.75	0.8	0.83	0.88	0.83	0.82	0.82	0.83	0.83
	SocE	0.87	0.84	0.84	0.82	0.8	0.81	0.83	0.84	0.86	0.89	0.92	0.95	0.93	0.92	0.92	0.93	0.94
	EnvE	0.59	0.67	0.67	0.68	0.73	0.83	0.87	0.82	0.85	0.82	0.86	0.9	0.95	0.94	0.94	0.95	0.96
Czechia	EcoE	0.86	0.77	0.83	0.88	0.87	0.85	0.83	0.85	0.85	0.9	0.95	0.96	0.92	0.91	0.91	0.92	0.93
	SocE	0.82	0.77	0.79	0.81	0.8	0.79	0.79	0.81	0.83	0.87	0.91	0.93	0.91	0.9	0.91	0.92	0.93
	EnvE	0.66	0.72	0.74	0.72	0.74	0.77	0.78	0.76	0.79	0.81	0.85	0.91	1	0.99	0.99	0.99	0.99
Estonia	EcoE	0.7	0.57	0.59	0.7	0.74	0.79	0.76	0.77	0.78	0.84	0.88	0.92	0.87	0.86	0.87	0.87	0.88
	SocE	0.69	0.65	0.66	0.7	0.72	0.74	0.76	0.77	0.79	0.83	0.87	0.9	0.9	0.89	0.89	0.9	0.91
	EnvE	0.65	0.7	0.65	0.66	0.66	0.65	0.65	0.71	0.71	0.69	0.72	0.83	0.96	0.95	0.95	0.96	0.97
Hungary	EcoE	0.81	0.72	0.73	0.75	0.74	0.73	0.78	0.81	0.82	0.88	0.93	0.99	0.97	0.96	0.97	0.97	0.99
	SocE	0.8	0.75	0.76	0.77	0.76	0.78	0.79	0.82	0.83	0.86	0.9	0.91	0.88	0.87	0.88	0.89	0.9
	EnvE	0.78	0.85	0.85	0.84	0.9	0.89	0.88	0.88	0.89	0.84	0.84	0.9	0.93	0.92	0.93	0.94	0.96
Lithuania	EcoE	0.69	0.51	0.52	0.6	0.66	0.7	0.72	0.74	0.75	0.81	0.89	0.94	0.9	0.89	0.9	0.91	0.92
	SocE	0.59	0.54	0.56	0.59	0.6	0.62	0.65	0.67	0.71	0.75	0.81	0.72	0.74	0.73	0.74	0.74	0.75
	EnvE	0.81	0.92	0.89	0.85	0.85	0.89	0.88	0.84	0.85	0.84	0.79	0.84	0.81	0.8	0.81	0.82	0.83
Latvia	EcoE	0.77	0.58	0.6	0.67	0.76	0.77	0.76	0.78	0.79	0.85	0.87	0.91	0.85	0.84	0.84	0.85	0.85
	SocE	0.69	0.62	0.63	0.65	0.68	0.7	0.71	0.73	0.75	0.78	0.85	0.9	0.9	0.89	0.91	0.92	0.92
	EnvE	0.84	0.87	0.87	0.89	0.87	0.87	0.86	0.86	0.87	0.84	0.83	0.82	0.88	0.87	0.88	0.89	0.91
Poland	EcoE	0.77	0.7	0.73	0.77	0.76	0.78	0.81	0.82	0.81	0.84	0.94	0.97	0.94	0.93	0.94	0.94	0.95
	SocE	0.7	0.69	0.72	0.73	0.73	0.73	0.74	0.75	0.76	0.8	0.87	0.91	0.91	0.9	0.91	0.92	0.93
	EnvE	0.77	0.83	0.83	0.84	0.86	0.87	0.89	0.9	0.92	0.89	0.9	0.96	0.97	0.96	0.96	0.97	0.97
Romania	EcoE	0.81	0.68	0.66	0.77	0.73	0.7	0.71	0.78	0.76	0.78	0.82	0.88	0.86	0.85	0.86	0.87	0.88
	SocE	0.71	0.66	0.67	0.68	0.68	0.71	0.72	0.71	0.75	0.8	0.72	0.77	0.77	0.76	0.77	0.78	0.79
	EnvE	0.68	0.76	0.8	0.77	0.8	0.84	0.86	0.86	0.92	0.94	0.93	0.92	0.99	0.98	0.98	0.99	0.99
Slovakia	EcoE	0.6	0.5	0.71	0.73	0.73	0.79	0.79	0.81	0.82	0.86	0.93	0.91	0.86	0.85	0.85	0.87	0.9
	SocE	0.75	0.73	0.78	0.8	0.8	0.79	0.79	0.82	0.83	0.86	0.89	0.91	0.91	0.9	0.92	0.93	0.95
	EnvE	0.6	0.65	0.66	0.7	0.74	0.78	0.79	0.79	0.83	0.83	0.86	0.92	1	0.99	0.99	0.99	1
Slovenia	EcoE	0.88	0.77	0.74	0.75	0.75	0.74	0.75	0.76	0.78	0.84	0.88	0.9	0.83	0.82	0.83	0.84	0.87
	SocE	0.84	0.8	0.82	0.83	0.81	0.81	0.83	0.84	0.87	0.89	0.92	0.94	0.94	0.93	0.95	0.97	0.98
	EnvE	0.69	0.73	0.73	0.74	0.77	0.79	0.84	0.87	0.89	0.9	0.89	0.91	0.98	0.97	0.98	0.98	0.99

Source: own study based on the Eurostat database, https://ec.europ a.eu/Eurostat, accessed: 04.12.2025.).

Between 2008 and 2024, Central and Eastern European countries saw a systematic increase in all three pillars of sustainable entrepreneurship – EcoE, SocE, and EnvE. These indicators synthetically reflect, respectively: the activity and development potential of enterprises,

the social impact of economic activity, and the impact of the business sector on the natural environment. An increase in EcoE indicates increasing economic efficiency, investment in innovation, and stabilisation of economic conditions. An increase in SocE indicates improved working conditions, the development of human capital, and increased inclusiveness in the labour market. An increase in EnvE, on the other hand, reflects the increasing ecological efficiency of enterprises, the implementation of pro-ecological technologies, and the importance of environmental protection policies. The highest values of individual indicators are observed in countries such as the Czechia, Estonia, Slovenia, and Slovakia, demonstrating a strong foundation for the development of sustainable entrepreneurship in the region.

Table 3 presents basic descriptive statistics for the synthetic indicators related to the pillars of sustainable entrepreneurship (SusE) – EcoE, SocE, EnvE in Central and Eastern European countries between 2008 and 2024.

An analysis of the synthetic indicators for the three pillars of sustainable entrepreneurship in Central and Eastern European countries from 2008 to 2024 reveals both common development trends and significant differences between countries. The presented table includes mean, median, minimum, maximum, and standard deviation values, allowing for a more comprehensive assessment of the stability and variability of individual pillars.

Considering EcoE, the mean values range from 0.77 (Lithuania, Bulgaria) to 0.88 (Czechia). The medians are close to the mean in most countries, indicating a relatively symmetrical distribution of the indicator. The highest median value was recorded in the Czechia (0.88), with high values also found in Poland, Hungary, Croatia, Slovakia, and Slovenia (around 0.82). The lowest median value is in Lithuania (0.75), confirming the greater instability of the economic conditions for entrepreneurship. The maximum values reach as high as 0.99 in Hungary, while the minimum values drop to 0.50 in Slovakia and 0.51 in Lithuania (indicating significant differences in the stability of economic conditions). The standard deviation of EcoE is highest in Lithuania (0.14) and Slovakia (0.11) - indicating significant temporal variability. The most stable conditions were recorded in the Czechia and Slovenia (0.05 each), as well as in Croatia (0.07). The countries with the highest average EcoE values – Czechia (0.88), Hungary (0.86), and Poland (0.85) – are characterised by a favourable economic environment and relatively high resilience to cyclical changes.

Regarding SocE, mean values range from 0.68 in Lithuania to 0.88 in Croatia and Slovenia. The highest medians are found in Croatia and Slovenia (both 0.87), as well as in the Czechia, Hungary, and Slovakia (around 0.83), indicating a consistently high level of the social pillar of entrepreneurship. The lowest median was again recorded in Lithuania (0.71). In Bulgaria, Poland, and Latvia, the medians are lower than the average, suggesting the impact of periodic increases on the average value. The maximum values reach 0.98 in Slovenia and 0.95 in Croatia, while the minimum values fall to 0.54 in Lithuania and 0.61 in Bulgaria. The standard deviations are lowest in Romania (0.04) and Slovenia (0.06) - indicating a high degree of stability in the social conditions for entrepreneurship. The greatest variability is observed in

Bulgaria (0.11) and Latvia (0.11). The highest mean SocE values, recorded in Slovenia and Croatia (both 0.88), indicate well-developed social capital, education, safety, and social support systems.

Mean EnvE values are generally high, ranging from 0.77 in Estonia and Bulgaria to 0.90 in Poland. The highest median values were recorded in Poland (0.90), Romania (0.92), Hungary, and Slovenia (both 0.89), confirming consistently high levels of environmental activities. The differences between the median and mean in Czechia and Estonia, however, indicate greater variability in this pillar over time. Maximum values reach 1.00 in Czechia and Slovakia, indicating that the highest possible values were achieved in selected years. The lowest minimum values are recorded in Croatia (0.59) and Slovakia (0.60). The standard deviation is lowest in Latvia (0.02) and Lithuania (0.03) - indicating stable and consistent development of environmental policies. The greatest variability is observed in Estonia (0.13), as well as in Slovakia and the Czechia (0.11 each). Countries with the highest average values - Poland (0.90), Romania (0.88), and Latvia (0.87) are distinguished by the intensive implementation of pro-environmental measures and the high effectiveness of their environmental policies.

Table 3.
Synthetic indicators of economic, social and environmental entrepreneurship, Central and Eastern European countries (2008-2024) – basic descriptive statistics

Country	Synthetic indicator (pillars of SusE)	Basic descriptive statistics				
		Mean	Standard deviation	Median	Max	Min
Bulgaria	EcoE	0.77	0.06	0.77	0.85	0.64
	SocE	0.75	0.11	0.72	0.90	0.61
	EnvE	0.77	0.08	0.76	0.88	0.64
Croatia	EcoE	0.80	0.07	0.82	0.97	0.70
	SocE	0.88	0.05	0.87	0.95	0.80
	EnvE	0.83	0.11	0.85	0.96	0.59
Czechia	EcoE	0.88	0.05	0.88	0.96	0.77
	SocE	0.85	0.06	0.83	0.93	0.77
	EnvE	0.84	0.11	0.79	1.00	0.66
Estonia	EcoE	0.79	0.10	0.79	0.92	0.57
	SocE	0.80	0.09	0.79	0.91	0.65
	EnvE	0.77	0.13	0.71	0.97	0.65
Hungary	EcoE	0.86	0.10	0.82	0.99	0.72
	SocE	0.83	0.06	0.83	0.91	0.75
	EnvE	0.88	0.04	0.89	0.96	0.78
Lithuania	EcoE	0.77	0.14	0.75	0.94	0.51
	SocE	0.68	0.08	0.71	0.81	0.54
	EnvE	0.84	0.03	0.84	0.92	0.79
Latvia	EcoE	0.78	0.09	0.79	0.91	0.58
	SocE	0.78	0.11	0.75	0.92	0.62
	EnvE	0.87	0.02	0.87	0.91	0.82
Poland	EcoE	0.85	0.09	0.82	0.97	0.70
	SocE	0.81	0.09	0.76	0.93	0.69
	EnvE	0.90	0.06	0.90	0.97	0.77
Romania	EcoE	0.79	0.07	0.78	0.88	0.66
	SocE	0.73	0.04	0.72	0.80	0.66
	EnvE	0.88	0.09	0.92	0.99	0.68

Cont. table 3.

Slovakia	EcoE	0.79	0.11	0.82	0.93	0.50
	SocE	0.84	0.07	0.83	0.95	0.73
	EnvE	0.83	0.13	0.83	1.00	0.60
Slovenia	EcoE	0.81	0.05	0.82	0.90	0.74
	SocE	0.88	0.06	0.87	0.98	0.80
	EnvE	0.86	0.10	0.89	0.99	0.69

Source: own study based on the Eurostat database, https://ec.europ a.eu/Eurostat, 04.12.2025.

Analysis of descriptive statistics for EcoE, SocE, and EnvE reveals relatively high levels of indicators (with notable differences in stability and variability among the studied countries). In most cases, the medians are close to the mean values, suggesting relatively symmetrical distributions of indicators over time. EcoE is characterised by moderate variability – the highest and most stable values were recorded in the Czechia, Poland, and Slovenia, while the greatest variability was observed in Lithuania and Slovakia. SocE exhibits high levels and stability in countries such as Slovenia, Croatia, and the Czech Republic, whereas it has lower and more volatile values in Bulgaria and Lithuania. EnvE, on the other hand, achieves the highest average values among the analysed areas, with particularly stable development observed in the Baltic States and Poland, and greater variability in Estonia, the Czechia, and Slovakia.

Table 4 presents the linear trend equations for the synthetic indicators related to the pillars of sustainable entrepreneurship (SusE) – EcoE, SocE, EnvE in Central and Eastern European countries between 2008 and 2024. These equations allow for an assessment of the direction and dynamics of change in the studied countries. The trend slopes provide information about the rate of change over time. The coefficients of determination R^2 indicate the degree of fit of the linear model to the empirical data and, therefore, the stability of the observed trends.

Regarding EcoE, positive slopes are observed in most of the analyzed countries, confirming the systematic improvement in economic conditions conducive to entrepreneurship. The strongest growth is in Lithuania (0.0256), Hungary (0.0190), Estonia (0.0177), and Poland (0.0165). At the same time, very weak trends were observed in Croatia (0.0014) and Slovenia (0.0060), indicating marginal changes in this area. An assessment of trend stability shows that the highest R^2 values were obtained in Poland (0.8593), Lithuania (0.8346), and Hungary (0.8270), indicating well-formed and regular upward trends. In contrast, the exceptionally low R^2 value in Croatia (0.0093) indicates the lack of a clear, stable economic trend over time. These results indicate that, despite the generally positive direction of change, the EcoE is characterized by significant variation in strength and stability across countries.

SocE in all analyzed countries exhibits positive slopes, indicating an improvement in the social conditions that influence entrepreneurship. The highest growth is in Bulgaria (0.0223) and Latvia (0.0212), as well as in Estonia (0.0179) and Poland (0.0172). The lowest slopes were observed in Romania (0.0076) and Croatia (0.0082) - indicating a slower pace of social change in these countries. At the same time, the social pillar is characterized by very high trend stability – the highest R^2 values were obtained in Slovakia (0.9456), Estonia (0.9324), Bulgaria (0.9212), and Poland (0.9069). The lowest linear model fit was observed in Croatia ($R^2 = 0.6676$),

although the trend remained upward there as well. This indicates that improving social conditions is a universal process, but its pace and regularity vary across countries.

EnvE is characterized by the greatest dynamics of change. In most countries, the growth rate is significantly higher than in the economic and social pillars. The highest slope values are observed in Slovakia (0.0261), Estonia (0.0233), the Czechia (0.0221), Croatia (0.0218), and Slovenia (0.0199). Very low growth was recorded in Latvia (0.0012) and Hungary (0.0073), and in Lithuania, the trend is negative (-0.0043), indicating a slight deterioration in the environmental pillar over time. Analysis of the coefficients of determination confirms the high stability of this pillar – the highest R^2 values were achieved in Slovakia (0.9636), Slovenia (0.9606), Romania (0.9220), Poland (0.9115), and the Czechia (0.9092). The lowest R^2 values are found in Latvia (0.0644) and Lithuania (0.3702), indicating high variability and no clear trend in these countries.

Table 4.
Synthetic indicators of economic, social and environmental entrepreneurship, Central and Eastern European countries (2008-2024) – trend lines

Country	Synthetic indicator (pillars of SusE)	Trend line
Bulgaria	EcoE	y = 0.0112x + 0.6674; R² = 0.7205
	SocE	y = 0.0223x + 0.5477; R² = 0.9212
	EnvE	y = 0.0149x + 0.6376; R² = 0.8609
Croatia	EcoE	y = 0.0014x + 0.788; R² = 0.0093
	SocE	y = 0.0082x + 0.8034; R² = 0.6676
	EnvE	y = 0.0218x + 0.6288; R² = 0.8892
Czechia	EcoE	y = 0.0075x + 0.8143; R² = 0.5818
	SocE	y = 0.0104x + 0.7584; R² = 0.8013
	EnvE	y = 0.0221x + 0.6367; R² = 0.9092
Estonia	EcoE	y = 0.0177x + 0.6279; R² = 0.7642
	SocE	y = 0.0179x + 0.6368; R² = 0.9324
	EnvE	y = 0.0233x + 0.5595; R² = 0.7789
Hungary	EcoE	y = 0.019x + 0.6849; R² = 0.827
	SocE	y = 0.0101x + 0.7413; R² = 0.8023
	EnvE	y = 0.0073x + 0.8178; R² = 0.6404
Lithuania	EcoE	y = 0.0256x + 0.5369; R² = 0.8346
	SocE	y = 0.014x + 0.5509; R² = 0.7744
	EnvE	y = -0.0043x + 0.8812; R² = 0.3702
Latvia	EcoE	y = 0.0144x + 0.6548; R² = 0.6205
	SocE	y = 0.0212x + 0.5879; R² = 0.9143
	EnvE	y = 0.0012x + 0.8555; R² = 0.0644
Poland	EcoE	y = 0.0165x + 0.6982; R² = 0.8593
	SocE	y = 0.0172x + 0.6513; R² = 0.9069
	EnvE	y = 0.0115x + 0.7962; R² = 0.9115
Romania	EcoE	y = 0.0117x + 0.683; R² = 0.6496
	SocE	y = 0.0076x + 0.6638; R² = 0.743
	EnvE	y = 0.0182x + 0.7188; R² = 0.922
Slovakia	EcoE	y = 0.0187x + 0.6262; R² = 0.7005
	SocE	y = 0.0132x + 0.726; R² = 0.9456
	EnvE	y = 0.0261x + 0.5957; R² = 0.9636
Slovenia	EcoE	y = 0.006x + 0.7538; R² = 0.2936
	SocE	y = 0.0116x + 0.7762; R² = 0.8775
	EnvE	y = 0.0199x + 0.6824; R² = 0.9606

Source: own study based on the Eurostat database, https://ec.europ a.eu/Eurostat, 04.12.2025.

In summary, the environmental pillar is characterised by the highest dynamics and the most pronounced growth trends, the social pillar by the greatest stability and consistency of change, while the economic pillar, despite positive trends, remains the most diverse among Central and Eastern European countries. These results confirm that the process of sustainable entrepreneurship in Central and Eastern Europe:

- is progressing multidimensionally,
- its pace and coherence depend on the specific characteristics of the given country and the prevailing development priorities.

Table 5 presents the sustainable entrepreneurship indicator (SusE) for Central and Eastern European countries from 2008 to 2024. The indicator provides an aggregated measure of the level of entrepreneurship development in economic, social, and environmental terms. Values ranging from 0 to 1. The higher values indicate higher levels of sustainable entrepreneurship in the analysed countries.

Data analysis reveals a clear and long-term upward trend in SusE across all analysed Central and Eastern European countries from 2008 to 2024. In the long term, a systematic increase in the level of sustainable entrepreneurship is observed (despite temporary declines or stagnation in the initial period – especially in the years 2009-2012, related to, among other things, the global financial crisis). The changes may indicate:

- the growing importance of sustainable development standards in economic policies and business practices,
- the gradual integration of economic, social, and environmental goals into enterprise development strategies,
- improved efficiency of the enterprise sector in a changing institutional and regulatory environment,
- increasing the adaptability of enterprises to macroeconomic, social, and environmental challenges.

Throughout the analysed period, the highest and most stable SusE values were achieved by the Czechia, Poland, Hungary, Slovakia, and Slovenia, reaching a value of approximately 0.95 in 2023-2024. It demonstrates a very high level of sustainable entrepreneurship development, resulting from relatively strong economic foundations, a high level of social development, and the effective implementation of pro-ecological solutions. The Baltic countries (Estonia, Lithuania, and Latvia) are characterised by dynamic growth in SusE values, especially after 2013, indicating consistent catching up and effective adaptation of enterprise structures to the requirements of sustainable development. On the other hand, Bulgaria and Romania, despite lower initial values, show a clear improvement in SusE levels (throughout the study period), suggesting a gradual strengthening of entrepreneurial potential and the growing importance of social and environmental aspects in economic activity. Notably, the strongest increase in the SusE occurred after 2015. It can be attributed to:

- intensification of EU policies regarding sustainable development and energy transition,
- increased investment in innovation and environmentally friendly technologies,
- improved quality of labour market institutions and employment conditions,
- strengthening corporate social responsibility (CSR) as a sustainable element of business models.

Table 5.
Synthetic indicator of sustainable entrepreneurship, Central and Eastern European countries (2008-2024)

Country	Synthetic indicator	Year																
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Bulgaria	SusE	0.69	0.68	0.65	0.65	0.68	0.71	0.71	0.72	0.74	0.77	0.80	0.85	0.87	0.86	0.86	0.87	0.88
Croatia	SusE	0.81	0.80	0.76	0.74	0.75	0.78	0.80	0.80	0.82	0.84	0.87	0.91	0.90	0.89	0.89	0.90	0.91
Czechia	SusE	0.78	0.75	0.79	0.80	0.80	0.80	0.80	0.81	0.82	0.86	0.90	0.93	0.94	0.93	0.94	0.94	0.95
Estonia	SusE	0.68	0.64	0.63	0.69	0.71	0.73	0.72	0.75	0.76	0.79	0.82	0.88	0.91	0.90	0.90	0.91	0.92
Hungary	SusE	0.80	0.77	0.78	0.79	0.80	0.80	0.82	0.84	0.85	0.86	0.89	0.93	0.93	0.92	0.93	0.93	0.95
Lithuania	SusE	0.70	0.66	0.66	0.68	0.70	0.74	0.75	0.75	0.77	0.80	0.83	0.83	0.82	0.81	0.82	0.82	0.83
Latvia	SusE	0.77	0.69	0.70	0.74	0.77	0.78	0.78	0.79	0.80	0.82	0.85	0.88	0.88	0.87	0.88	0.89	0.89
Poland	SusE	0.75	0.74	0.76	0.78	0.78	0.79	0.81	0.82	0.83	0.84	0.90	0.95	0.94	0.93	0.94	0.94	0.95
Romania	SusE	0.73	0.70	0.71	0.74	0.74	0.75	0.76	0.78	0.81	0.84	0.82	0.86	0.87	0.86	0.87	0.88	0.89
Slovakia	SusE	0.65	0.63	0.72	0.74	0.76	0.79	0.79	0.81	0.83	0.85	0.89	0.91	0.92	0.91	0.92	0.93	0.95
Slovenia	SusE	0.80	0.77	0.76	0.77	0.78	0.78	0.81	0.82	0.85	0.88	0.90	0.92	0.92	0.91	0.92	0.93	0.95

Source: own study based on the Eurostat database, https://ec.europ a.eu/Eurostat, 04.12.2025.

In summary, between 2008 and 2024, Central and Eastern European countries have seen significant progress in sustainable entrepreneurship. The growth of SusE confirms a gradual shift from an entrepreneurship model primarily based on economic growth to a more sustainable approach that simultaneously considers social and environmental aspects.

Table 6 presents basic descriptive statistics for the synthetic sustainable entrepreneurship indicator (SusE) for Central and Eastern European countries from 2008 to 2024. The summary includes mean values, medians, minimum values, maximum values, and standard deviations, enabling the assessment of both the level of sustainable entrepreneurship development and its stability and variability over time.

Analysis of the mean values indicates a relatively high yet varied level of SusE across the studied countries. The highest mean values are achieved in Czechia and Hungary (both 0.86), as well as in Poland and Slovenia (both 0.85) - indicating a well-developed, sustainable entrepreneurship model that integrates economic, social, and environmental aspects. The lowest mean values were recorded in Bulgaria and Lithuania (both 0.76) and Estonia (0.78), which may indicate a slower pace of integrating individual pillars of sustainable development into business operations. The SusE medians are very close to the mean values in most countries, suggesting a relatively symmetrical distribution of observations over time. The highest median values are found in Slovenia (0.85) and Hungary (0.85), as well as in Poland and the Czechia (0.83 and 0.82, respectively). The lowest median values are found in Bulgaria (0.74) and Estonia (0.76), confirming the more volatile and less stable development of sustainable

entrepreneurship in these countries. The range of variation of the SusE, defined by the minimum and maximum values, indicates significant differences between countries. The highest maximum values (0.95) are achieved in Czechia, Hungary, Poland, Slovakia, and Slovenia, indicating a very high level of implementation of sustainable entrepreneurship principles in the final years of the analysed period. In contrast, the lowest minimum values are in Estonia and Slovakia (0.63 each), as well as in Bulgaria (0.65) - indicating a greater sensitivity of these economies to economic fluctuations or delays in implementing the sustainable development concept in its initial phases. The standard deviation confirms the varying degree of stability of the SusE over time. The highest volatility is observed in Estonia and Slovakia (both 0.10) and Poland (0.08), which may reflect dynamic transformation processes and a rapid pace of catching up. The most stable SusE values were recorded in Croatia, Lithuania, Latvia, Romania, and Slovenia (standard deviation of 0.06), indicating more fluid and gradual changes in sustainable entrepreneurship.

Table 6.
Synthetic indicator of sustainable entrepreneurship, Central and Eastern European countries (2008-2024) – basic descriptive statistics

Country	Synthetic indicator	Basic descriptive statistics				
		Mean	Standard deviation	Median	Max	Min
Bulgaria	SusE	0.76	0.08	0.74	0.88	0.65
Croatia	SusE	0.83	0.06	0.82	0.91	0.74
Czechia	SusE	0.86	0.07	0.82	0.95	0.75
Estonia	SusE	0.78	0.10	0.76	0.92	0.63
Hungary	SusE	0.86	0.06	0.85	0.95	0.77
Lithuania	SusE	0.76	0.06	0.77	0.83	0.66
Latvia	SusE	0.81	0.06	0.80	0.89	0.69
Poland	SusE	0.85	0.08	0.83	0.95	0.74
Romania	SusE	0.80	0.06	0.81	0.89	0.70
Slovakia	SusE	0.82	0.10	0.83	0.95	0.63
Slovenia	SusE	0.85	0.06	0.85	0.95	0.76

Source: own study based on the Eurostat database, https://ec.europ a.eu/Eurostat, 04.12.2025.

Descriptive statistics of the SusE indicate that Central and Eastern European countries are demonstrating significant progress in sustainable entrepreneurship, with varying levels and dynamics of change across countries. The highest average and maximum values are achieved by countries with relatively strong institutional and economic foundations, confirming the crucial role of a stable economic, social, and regulatory environment in the long-term development of sustainable entrepreneurship.

Table 7 presents the linear trend equations for the synthetic indicator of sustainable entrepreneurship (SusE) in Central and Eastern European countries from 2008 to 2024. These equations enable us to assess the direction and dynamics of long-term changes in sustainable entrepreneurship levels. The coefficients of determination, R^2, provide information on the degree of fit of the linear models to the empirical data, and therefore, on the stability of the observed trends.

All analysed countries exhibit positive slopes, which clearly confirm the systematic increase in SusE throughout the study period. It indicates a consistent improvement in the integration of economic, social, and environmental dimensions within the enterprise sector in Central and Eastern European countries. The highest growth dynamics are observed in Estonia (0.0196), Slovakia (0.0193), Bulgaria (0.0161), and Poland (0.0151). It indicates intensive convergence processes and rapid catching up in terms of sustainable entrepreneurship. In these countries, the observed improvement was clear and systematic, as confirmed by high values of the coefficients of determination. Slightly lower, but still significantly positive, growth rates were recorded in the Czechia (0.0134), Hungary (0.0121), Latvia (0.0122), Romania (0.0125), Slovenia (0.0125), and Lithuania (0.0118). These values indicate a stable, albeit more moderate, dynamic of change, characteristic of countries with relatively higher initial levels of the SusE. The slowest rate of growth in SusE was observed in Croatia (0.0105), which may suggest that an earlier level of sustainable entrepreneurship was achieved or that the pace of further change was slower during the analysed period.

Analysis of the R^2 coefficients of determination indicates a very good fit of the linear models to the empirical data in all the studied countries. The highest R^2 values were obtained in Romania (0.9412), Slovakia (0.9403), Estonia (0.9390), and Poland (0.9369), confirming the existence of strong, regular, and stable upward trends. High R^2 values were also found in Hungary (0.9276), Bulgaria (0.9076), the Czechia (0.9000), and Slovenia (0.8976). The lowest, although still relatively high, trend fit was observed in Croatia (0.7727), which may indicate larger fluctuations in the SusE over time or a more complex course of change, less well described by a simple linear model.

Table 7.
Synthetic indicator of sustainable entrepreneurship, Central and Eastern European countries (2008-2024) – trend lines

Country	Synthetic indicator	Trend line
Bulgaria	SusE	$y = 0.0161x + 0.6176$; $R^2 = 0.9076$
Croatia	SusE	$y = 0.0105x + 0.74$; $R^2 = 0.7727$
Czechia	SusE	$y = 0.0134x + 0.7364$; $R^2 = 0.9$
Estonia	SusE	$y = 0.0196x + 0.6081$; $R^2 = 0.939$
Hungary	SusE	$y = 0.0121x + 0.748$; $R^2 = 0.9276$
Lithuania	SusE	$y = 0.0118x + 0.6563$; $R^2 = 0.8633$
Latvia	SusE	$y = 0.0122x + 0.6994$; $R^2 = 0.8875$
Poland	SusE	$y = 0.0151x + 0.7152$; $R^2 = 0.9369$
Romania	SusE	$y = 0.0125x + 0.6885$; $R^2 = 0.9412$
Slovakia	SusE	$y = 0.0193x + 0.6493$; $R^2 = 0.9403$
Slovenia	SusE	$y = 0.0125x + 0.7375$; $R^2 = 0.8976$

Source: own study based on the Eurostat database, https://ec.europ a.eu/Eurostat, 04.12.2025.

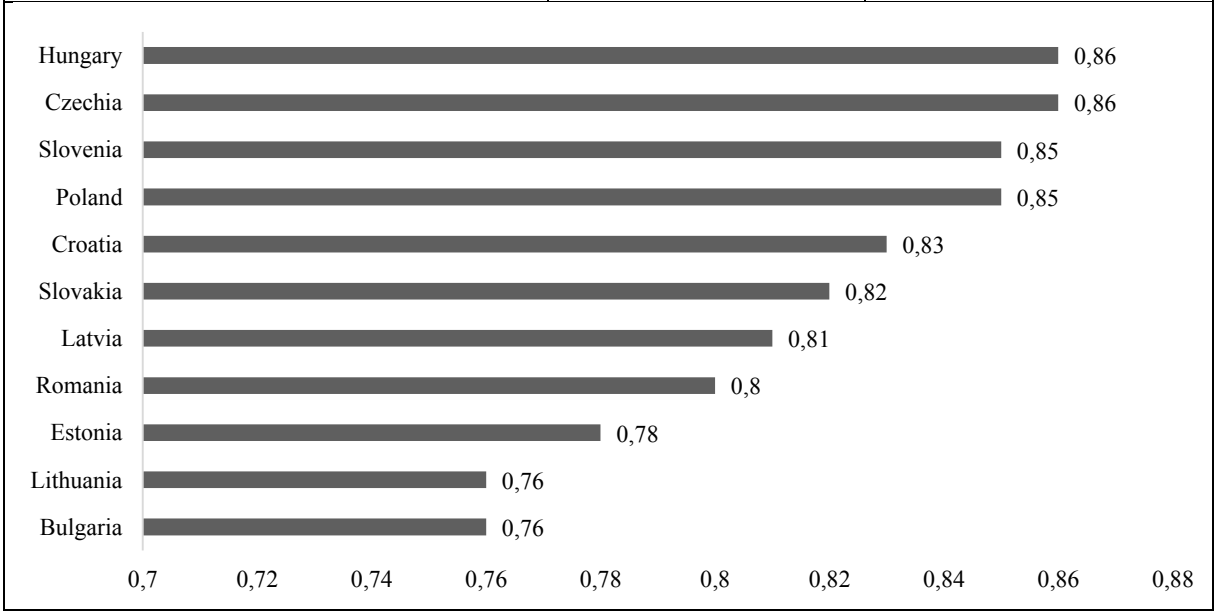
The results presented in table 7 indicate a clear, long-term increase in the synthetic indicator of sustainable entrepreneurship across all Central and Eastern European countries. High values of the coefficients of determination confirm the stability and consistency of the observed trends, while the variation in the directional coefficients indicates varying rates of implementation of

sustainable entrepreneurship principles, depending on the economic, institutional, and structural characteristics of individual countries. These results confirm that the process of developing sustainable entrepreneurship in the region is gradual, yet lasting and systematic.

Table 8 presents the sustainable entrepreneurship ranking for Central and Eastern European countries from 2008 to 2024. The ranking is based on the average values of the synthetic sustainable entrepreneurship indicator (SusE) for Central and Eastern European countries from 2008 to 2024. It is intended as a ranking and complements the statistical analysis, enabling the synthetic identification of leaders and countries with relatively lower levels of sustainable entrepreneurship.

Table 8.
Sustainable entrepreneurship ranking for Central and Eastern European countries (2008-2024)

Sustainable entrepreneurship - ranking of Central and Eastern European countries		
Position in the ranking	**Country**	**Mean of SusE**
1-2	Czechia	0.86
1-2	Hungary	0.86
3-4	Poland	0.85
3-4	Slovenia	0.85
5	Croatia	0.83
6	Slovakia	0.82
7	Latvia	0.81
8	Romania	0.8
9	Estonia	0.78
10-11	Bulgaria	0.76
10-11	Lithuania	0.76



Source: own study based on the Eurostat database, https://ec.europ a.eu/Eurostat, 04.12.2025.

Czechia and Hungary occupy the highest positions, followed closely by Poland and Slovenia, confirming their sustained advantage in integrating economic, social, and environmental dimensions. Bulgaria and Lithuania, on the other hand, remain among the countries with the lowest average SusE values, despite an upward trend observed over time.

5. Discussion

The empirical findings confirm that, between 2008 and 2024 in Central and Eastern European countries experienced a systematic increase in the level of sustainable entrepreneurship, measured by the synthetic indicator SusE. This result is consistent with a growing body of literature that highlights the progressive integration of economic, social and environmental objectives in economic activities - particularly in economies operating within the European Union regulatory framework (Shepherd, Patzelt, 2011; Farny, Binder, 2021; Rosário, Figueiredo, 2024). The observed upward trend supports the argument that sustainable entrepreneurship is increasingly perceived not as an alternative model but as an integral component of long-term economic development.

The analysis of the economic pillar (EcoE) reveals relatively high dynamics in countries that initially exhibited lower levels of economic development, such as Lithuania, Estonia, and Poland. This finding aligns with the convergence hypothesis and is consistent with earlier studies indicating that catching-up economies tend to experience faster improvements in entrepreneurial performance under conditions of institutional stabilisation and access to EU funds (Kowalska, Misztal, 2023; Kowalska et al., 2024). At the same time, the observed variation in the stability of EcoE trends across countries (particularly in smaller or structurally constrained economies) confirms the role of economic structure and vulnerability to external shocks, highlighted in institutional and resource-based theories of entrepreneurship (Cohen, Winn, 2007; Atobishi, Podruzsik, 2025).

The social pillar (SocE) proved to be the most stable component of sustainable entrepreneurship over the analysed period. This stability is consistent with the assumptions of human capital theory and inclusive growth frameworks - emphasise the long-term and path-dependent nature of changes in employment conditions, labour productivity, and social security systems (Diepolder et al., 2021; Rosário et al., 2022). High and stable SocE values observed in countries such as Slovenia, Czechia, and Croatia reflect the institutional maturity of labour markets and confirm earlier findings that social dimensions of sustainable entrepreneurship evolve more gradually than economic or environmental ones (Farny, Binder, 2021).

The environmental pillar (EnvE) exhibited the highest dynamics of change, which strongly supports the theoretical arguments stressing the role of regulatory pressure and policy-driven incentives in shaping pro-environmental entrepreneurial behaviour (Dean, McMullen, 2007; Schaltegger, 2015). The rapid growth of EnvE in most countries confirms that EU climate and environmental policies act as a significant catalyst for green innovation and technological modernisation. This result aligns with recent empirical studies, which demonstrate that regulatory frameworks can transform environmental constraints into entrepreneurial opportunities (Bakry et al., 2022; Alkathiri et al., 2024). However, weaker or less stable trends

observed in Lithuania and Latvia suggest that regulatory stimuli alone may be insufficient without complementary technological capabilities and sectoral adaptation.

A comparative analysis of the three pillars reveals that the development of sustainable entrepreneurship in Central and Eastern Europe follows an asymmetric yet interdependent trajectory. Although all dimensions demonstrate upward trends, their pace and stability differ across countries, confirming that a complex interaction of institutional quality, economic structure, and public policy priorities shapes sustainable entrepreneurship. The identified systemic effect, whereby improvements in one pillar stimulate progress in others, supports the holistic understanding of sustainable entrepreneurship proposed in the Triple Bottom Line framework and contemporary sustainability-oriented entrepreneurship theories (Elkington, 1997; Shepherd, Patzelt, 2011). At the same time, the differentiated national trajectories highlight the importance of country-specific conditions in shaping sustainable entrepreneurial outcomes.

6. Conclusions

This study presents a comprehensive and comparative assessment of sustainable entrepreneurship development in Central and Eastern Europe from 2008 to 2024 (providing both theoretical and empirical insights into the dynamics of sustainability-oriented entrepreneurial activity in post-transition economies). The results clearly demonstrate that sustainable entrepreneurship in the region has evolved in a systematic and multidimensional manner, encompassing simultaneous improvements in economic, social, and environmental dimensions.

One of the key contributions of this research is the identification of heterogeneous national development paths combined with a gradual convergence process. While countries such as: Czechia, Poland, Hungary, Slovakia, and Slovenia maintain leading positions due to stronger economic foundations, mature labour market institutions, and more advanced environmental policies, countries with lower initial levels of sustainable entrepreneurship exhibit relatively higher growth dynamics. This finding extends existing convergence-oriented theories by demonstrating that catch-up processes also apply to sustainability-oriented entrepreneurship, not just to traditional economic indicators.

The analysis highlights the differentiated roles of individual pillars. The environmental dimension emerged as the most dynamic component - confirming the strong influence of EU climate and environmental regulations on entrepreneurial behaviour. In contrast, the social pillar exhibited the highest stability over time, reflecting the long-term and institutionally embedded nature of labour market and social security systems. These findings reinforce

theoretical perspectives that emphasise the asymmetric yet interdependent evolution of sustainability dimensions within entrepreneurial systems.

Importantly, the study demonstrates the existence of a systemic effect in sustainable entrepreneurship development, whereby progress in one pillar supports improvements in others. This result provides empirical support for holistic frameworks such as the Triple Bottom Line and sustainability-oriented entrepreneurship theories, confirming that sustainable entrepreneurship should be analysed as an integrated system rather than as a set of isolated dimensions.

Despite its contributions, the study is subject to several limitations. First, the analysis is conducted at the macroeconomic level, which limits the ability to capture firm-level heterogeneity and sector-specific dynamics. Second, the construction of the synthetic indicator relies on the selection and aggregation of available secondary data, which may not fully reflect qualitative aspects of entrepreneurial sustainability, such as organisational culture or managerial intentions. Third, equal weighting of the indicator components (while methodologically justified) may obscure differences in the relative importance of individual pillars across countries.

These limitations indicate directions for future research. Further studies could incorporate micro- and meso-level data, explore sectoral differences, and apply alternative weighting or validation methods. Extending the analysis to include institutional, technological, and financial determinants would allow for a deeper understanding of the mechanisms driving sustainable entrepreneurship in transition economies.

From a broader perspective, the findings of this study are relevant not only to academic research but also to public policy and support systems for entrepreneurship. The results may support policymakers in designing more coherent and targeted strategies that simultaneously promote economic competitiveness, social inclusion, and environmental responsibility. Moreover, the proposed synthetic indicator can serve as a practical analytical tool for monitoring the development of sustainable entrepreneurship over time and evaluating the effectiveness of policy interventions at both national and regional levels.

References

1. Abbas, M.H., Bulut, M. (2024). Navigating the landscape of sustainable entrepreneurship research: A systematic literature review. *Discover Sustainability, 5*(171). https://doi.org/10.1007/s43621-024-00293-4
2. Alkathiri, N.A., Said, F.B., Meyer, N. et al. (2024). Knowledge management and sustainable entrepreneurship: A bibliometric overview and research agenda. *Journal of Innovation and Entrepreneurship, 13*(38). https://doi.org/10.1186/s13731-024-00387-3

3. Al-Thani, M.J., Koc, M. (2024). Development of an alternative sustainable economy index: Integrating multidimensional sustainability features. *Sustainability, 16*(18), 7956. https://doi.org/10.3390/su16187956
4. Atobishi, T., Podruzsik, S. (2025). Ethical entrepreneurial leadership and corporate sustainable development: A resource-based view of competitive advantage in small and medium enterprises. *Sustainability, 17*(13), 6109. https://doi.org/10.3390/su17136109
5. Bakry, D.S., Daim, T., Dabic, M., Yesilada, B. (2022). An evaluation of the effectiveness of innovation ecosystems in facilitating the adoption of sustainable entrepreneurship. *Journal of Small Business Management, 62*(2), 763-789. https://doi.org/10.1080/00472778.2022.2088775
6. Bakry, D., Daim, T., Alzahrani, S., Dabic, M., Yesilada, B. (2024). Exploring innovation ecosystems to facilitate the adoption of sustainable entrepreneurship: Looking beyond the Western world. *Journal of Small Business Management, 63*(1), 337-387. https://doi.org/10.1080/00472778.2024.2319782
7. Bindeeba, D.S., Bakashaba, R., Tukamushaba, E.K., Atuhaire, S. (2025). From green HRM to sustainable business performance: A two-stage meta-analytic SEM of the mediating role of green innovation. *Cogent Business & Management, 12*(1). https://doi.org/10.1080/23311975.2025.2536678
8. Cohen, B., Winn, M.I. (2007). Market imperfections, opportunity and sustainable entrepreneurship. *Journal of Business Venturing, 22*(1), 29-49. https://doi.org/10.1016/j.jbusvent.2004.12.001
9. Csákné Filep, J., Timár, G., Szennay, Á. (2025). Analysing the impact of entrepreneurship education on early-stage entrepreneurship—Focusing on the transitional countries of Central and Eastern Europe. *Administrative Sciences, 15*(2), 36. https://doi.org/10.3390/admsci15020036
10. Dean, T.J., McMullen, J.S. (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing, 22*(1), 50-76. https://doi.org/10.1016/j.jbusvent.2005.09.003
11. Diepolder, C.S., Weitzel, H., Huwer, J. (2021). Competence frameworks of sustainable entrepreneurship: A systematic review. *Sustainability, 13*(24), 13734. https://doi.org/10.3390/su132413734
12. Diepolder, C.S., Weitzel, H., Huwer, J. (2024). Exploring the impact of sustainable entrepreneurial role models on students' opportunity recognition for sustainable development in sustainable entrepreneurship education. *Sustainability, 16*(4), 1484. https://doi.org/10.3390/su16041484
13. Farny, S., Binder, J. (2021). Sustainable entrepreneurship. In L.-P. Dana (Ed.), *World Encyclopedia of Entrepreneurship* (2nd ed., pp. 605-611). Edward Elgar.
14. Gutterman, A.S. (2024). *Sustainable entrepreneurship* (open chapter). ResearchGate preprint/book chapter.

15. Halberstadt, J. et al. (2024). Towards a typology of sustainability entrepreneurs. *Journal of Business Research.* https://doi.org/10.1016/j.jbusres.2023.113851
16. Kowalska, M., Misztal, A. (2023). *Zrównoważona przedsiębiorczość i jej determinanty: Przypadek Polski* (wyd. online). Wydawnictwo Rys.
17. Kowalska, M., Misztal, A., Matera, R. (2024). The impact of economic security on sustainable entrepreneurship in Central and Eastern Europe – from the financial crisis to the COVID-19 pandemic. *Comparative Economic Research. Central and Eastern Europe, 27*(1), 67-92. https://doi.org/10.18778/1508-2008.27.04
18. Mondal, S., Singh, S., Gupta, H. (2025). Analyzing the indicators of green entrepreneurship for the sustainable circular economy: A mixed-method approach. *Benchmarking: An International Journal,* https://doi.org/10.1108/BIJ-04-2024-0356
19. Ribeiro, G.K.A., Leitão, J. (2024). Sustainable leadership and sustainable entrepreneurship: A systematic literature review. *Discover Sustainability, 5*(188). https://doi.org/10.1007/s43621-024-00383-3
20. Rosário, A.T., Figueiredo, J. (2024). Sustainable entrepreneurship and corporate social responsibility: Analysing the state of research. *Sustainable Environment, 10*(1). https://doi.org/10.1080/27658511.2024.2324572
21. Rosário, A.T., Cruz, A.R., Pires, A. (2022). Sustainable entrepreneurship: A literature review. *Sustainability, 14*(9), 5556. https://doi.org/10.3390/su14095556
22. Schaltegger, S. (2015, March). *Sustainable entrepreneurship* (slides for G-Forum workshop). Leuphana University. FGF – Forschungsnetzwerk.
23. Shepherd, D.A., Patzelt, H. (2011). The new field of sustainable entrepreneurship: Studying entrepreneurial action linking "what is to be sustained" with "what is to be developed". *Entrepreneurship Theory and Practice, 35*(1), 137-163. https://doi.org/10.1111/j.1540-6520.2010.00426.x
24. Sulong, Z., Chowdhury, M.A.F., Abdullah, M., Hall, C.M. (2024). Constructing sustainable halal tourism composite performance index for the global halal tourism industry. *Asia Pacific Journal of Tourism Research, 29*(7), 852-868. https://doi.org/10.1080/10941665.2024.2350413