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ORIGINAL CONTRIBUTION

Sustainable Development and ESG Approaches in the Transformation of Regional Economic Systems

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Abstract— The article examines how sustainable development principles and ESG approaches shape regional economic policy amid growing environmental, social, and institutional challenges. It argues that, in the context of developing regional economic systems, ESG should be considered more broadly than merely a corporate reporting tool. It can serve as a practical analytical approach to assessing spatial change, taking into account environmental modernization, social sustainability, management efficiency, and the region's investment and innovation capabilities. The study aims to develop an analytical model for assessing the ESG maturity of regional economic systems and to support the use of ESG approaches in policies aimed at their structural transformation. The methodology combines systems, institutional, and indicator-based approaches together with analysis and synthesis, comparison, indicator normalization, multicriteria assessment, typology, and matrix modeling. As a result, the paper proposes the structure of an integrated regional ESG transformation index, systematizes data sources for its calculation, develops a typology of regional economic systems, and formulates a matrix of regional ESG solutions. The findings show that ESG's practical value lies in its ability to connect strategic development goals with investment instruments, governance procedures, and performance monitoring. The article concludes that the effectiveness of ESG transformation depends not on the number of separate programs but on the consistency of the environmental, social, governance, and investment blocks as well as on the quality of regional statistics and the institutional capacity of public authorities.

Index Terms— Sustainable regional development, Digital transformation, ESG, regional economy, Green transition

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Introduction

The transition to a sustainable development model significantly changes the priorities of regional economic policy. Whereas territorial competitiveness used to be assessed mainly through growth rates, investment activity, or sectoral specialization, these measures are no longer sufficient. A region can have positive economic development indicators while facing accumulating environmental problems, declining human capital, governance shortcomings, or significant dependence on physically and technologically outdated infrastructure. That is why modern

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studies consider factors such as environmental safety, social cohesion, institutional transparency, and territories' adaptability to long-term change (European Commission, 2019; OECD, 2020, 2023; United Nations, 2015).

Under these conditions, the ESG approach becomes important not only in corporate governance but also in the processes of territorial development and modernization. Its use makes it possible to assess regional development in key interrelated areas, in particular, the efficiency of resource use, the level of social inclusion, the reliability of institutions, and a favorable investment environment. This approach has practical significance for regional policy, since the problems of individual territories are not limited to one sector. For example, the level of energy efficiency simultaneously affects the costs of enterprises, the imperfection of institutions reduces the willingness of investors to invest, and high social vulnerability complicates the implementation of structural transformations (EFRAG, 2024; European Commission, 2021, 2023; European Parliament and Council of the European Union, 2022; Salvatierra Melgar et al., 2025).

The main scientific problem is the lack of comprehensive approaches to assessing territorial development. Economic, environmental, social, and institutional indicators are often considered in isolation because their mutual influence is often overlooked when making management decisions. In regional planning, this can create a gap between declared sustainable development goals and the mechanisms for implementing them. Thus, strategic documents can set the course for sustainable development, but investment decisions, budget planning, and results monitoring remain insufficiently coordinated. In this regard, a comprehensive model is needed that combines ESG indicators with the processes of structural adjustment and renewal of the regional economy (Eurostat, 2024; OECD, 2024a, 2024b; World Bank, 2025a).

Based on the outlined scientific problem, this study aims to find answers to the following research questions:

1. How can the principles of sustainable development and the ESG approach, which are usually applied at the corporate level, be adapted to assess the structural transformation of regional economic systems?

2. What indicators and analytical blocks are necessary and sufficient to build a comprehensive model for assessing the ESG maturity of a region, combining environmental, social, management, and investment and innovation aspects?

3. What types of regional economic systems can be distinguished by their ESG profile, and what policy instruments are most relevant for each of these groups?

Literature Review

In contemporary scholarship, sustainable regional development is treated as a multidimensional process in which economic productivity is not separated from social justice, environmental safety, and institutional quality. This perspective is clearly reflected in OECD research, where regional well-being is understood more broadly than income and includes access to services, safety, environmental conditions, education, health, and civic participation (Naz & Nadim, 2025; OECD, 2020, 2024b; Syed et al., 2026). For the present article, this broader view is essential because regional ESG maturity cannot be assessed only through financial or production performance.

In European statistical practice, increasing attention is given to measuring regional progress through sustainable development indicators. Eurostat provides the corresponding information base at the regional level, enabling the comparison of territories in terms of energy efficiency, labour markets, innovation, social inclusion, and quality of the living environment (Dligach et al., 2025; Eurostat, 2024, 2025a, 2025b). At the same time, these data do not always directly correspond to the tasks of ESG analysis and therefore require interpretation and grouping according to environmental, social, governance, and investment logic.

The environmental dimension of ESG at the regional level is associated with emissions, energy structure, waste management, climate adaptation, and the efficient use of natural resources. Relevant analytical frameworks are consistently developed in European Environment Agency documents and in reports on progress towards the Sustainable Development Goals (European Environment Agency, 2024; Eurostat, 2025a, 2025b; United Nations Environment Programme, 2024). For regions, this dimension has not only environmental but also economic significance, as environmental risks affect business costs, public health, infrastructure quality, and the ability to attract green finance (Burkhanov et al., 2026; Kozminykh & Klochkov, 2026).

In scientific works, the governance component of ESG is usually considered through such characteristics as openness of government activities, accountability, combating corruption, quality of regulatory regulation and the ability to implement comprehensive policies covering various areas. The World Governance Indicators and the European Sustainability Reporting Standards (EFRAG, 2024; European Parliament and Council of the European Union, 2022; Shabbir et al., 2024; World Bank, 2025a, 2025b) are important for assessing regional development. Despite the fact that these sources do not always contain sufficient information on individual regions, they allow researchers to form a general idea of the role of governance quality in ensuring the sustainable development of territories.

At the same time, a certain discrepancy between the corporate understanding of ESG and the needs of regional development can be traced in the scientific literature. Some studies are mainly focused on corporate reporting, while others use macroeconomic and meso-level indicators of well-being, without defining clear approaches to their practical combination in the regional governance system (Hrechanyk et al., 2025; OECD, 2024a, 2024b; World Bank, 2025a). In view of this, the article uses the ESG approach as a tool for combining the principles of sustainable financing, regional statistics, and management decisions aimed at structural changes in the territorial economy.

The regulatory and methodological framework of ESG in Europe is shaped by the CSRD, ESRS, the EU taxonomy for sustainable finance, and the IFRS Sustainability Disclosure Standards. This means that ESG is gradually becoming not only an assessment tool but also a mechanism for

standardizing strategic decisions, financing practices, and reporting procedures (EFRAG, 2024; European Commission, 2021, 2023; European Parliament and Council of the European Union, 2022; IFRS Foundation, 2023a, 2023b). For regions, this trend has practical importance: territories able to describe their projects in ESG terms obtain better preconditions for partnerships, grant financing, and long-term capital attraction.

Modern scholars have investigated key aspects of the researched issues. In particular, the publication by Voronina et al. (2024) examines the integration of environmental and economic components in sustainable development management, which is relevant to foundation of the ESG concept (in particular, the environmental "E" and managerial "G" pillars). In contrast, the works by Koval, Kryshtal, et al. (2023) and Koval, Mikhno, et al. (2023) consider the circular economy as a core element of modern environmental management of enterprises and regions. The authors analyze sustainable consumption and involvement in cyclical processes, which provides insights into the practical implementation of ESG principles at the mesolevel.

The study by Arsawan et al. (2024) examines the driving forces of the circular economy, i.e. green human resource management, to establish indicators of sustainable development and environmental dynamism as moderating variables. In continuation, Nekhai et al. (2024) reveal the regional dimension of the issue. The results obtained by the authors demonstrated the need to apply a systemic and vector approach to the functioning of territorial communities under conditions of geopolitical conflicts.

It is worth noting separately that modern ESG approaches and monitoring of sustainable development are increasingly depends on digital tools. In particular, the study by Bielialov et al. (2023) is devoted to the global experience of digitalization of economic processes in the context of transformation. The study identifies the most important theoretical aspects of issues related to the use of digital technologies in the economies of different countries.

Finally, Trypolska et al. (2023) provided a clear understanding of the evolution and recent trends in research on the energy efficiency of residential buildings and renewable energy. The transition to renewable energy and energy efficiency are key requirements of the ESG environmental criterion, which underscores the need for further analysis of green energy development trends at the household level for further substantiation of regional energy transformations. Despite the significant interest of scientists in the researched issue, a number of aspects remain insufficiently explored.

Although modern scientific literature offers separate integrated indices for assessing sustainable development at the regional level (in particular, the OECD regional well-being indices, Eurostat aggregate indicators for monitoring the Sustainable Development Goals, as well as separate national methodologies for assessing the environmental and social components), these approaches are mostly focused on describing the final results without clearly taking into account the management and investment logic of ESG. At the same time, existing corporate ESG ratings are not adapted to the spatial dimension and do not take into account the specifics of territorial economic complexes. The model proposed in this article is distinguished by the fact that it integrates four blocks (environmental, social, management and investment and innovation) into a single regional policy instrument that directly links diagnostics with a matrix of management decisions. Thus, the novelty of the work lies not in the creation of another rating, but in the development of an analytical construct that allows researchers and policymakers to move from fragmented monitoring to systematic planning of transformational shifts at the mesolevel. A critical analysis of the cited sources (Arsawan et al., 2024; Bielialov et al., 2023; Koval, Kryshtal, et al., 2023; Koval, Mikhno, et al., 2023; Nekhai et al., 2024; Trypolska et al., 2023; Voronina et al., 2024) shows that they mainly highlight individual aspects (circular economy, digitalization, energy efficiency) without forming a holistic approach to assessing the ESG maturity of regions, which justifies the feasibility of developing the proposed model.

Thus, existing regional sustainability indices, such as the OECD Regional Well-Being or Eurostat indicators for SDGs, mainly capture the achieved results, but do not integrate them into the logic of ESG management decisions. They do not answer the question of how to move from problem diagnosis to systemic planning of transformational shifts. In turn, corporate ESG ratings are not adapted to the spatial (meso-) dimension. This study fills this gap by developing an analytical construct that does not simply create another rating, but directly links diagnostics to the management decision matrix, adding to the traditional E, S, G components the investment and innovation block (I), which is critically important for regional economic dynamics.

It is worth noting that the model proposed in this article is a conceptual construct that forms the theoretical and methodological basis for assessing the ESG maturity of regional systems. It does not claim the status of a fully validated tool, but instead creates the necessary prerequisites for further empirical testing. That is why the main attention is paid to the development of the logic of the integration of disparate indicators, the typology of regions, and the matrix of management decisions, while the direct ranking of territories based on statistical data is identified as a promising direction for further research.

The aim of the study is to develop an analytical model for assessing the ESG maturity of regional economic systems and to substantiate the use of ESG approaches in policies aimed at their structural transformation.

Methods

The methodological basis of the study combines systems, institutional, and indicator-based approaches. The systems approach treats a region as an open socio-economic system in which environmental, social, governance and investment processes interact with each other. The institutional approach emphasizes the role of rules, procedures, transparency and the capacity of public authorities. The indicator approach makes it possible to quantify ESG maturity through comparable variables.

The theoretical basis for applying the ESG approach to assessing regional development is the concept of a region as a complex socio-ecological-economic system. This system is characterized not only by capital flows and production, but also by the quality of human capital, the state of the environment and the effectiveness of institutions. That is why the four proposed blocks (E, S, G, I) are not isolated, but are considered interconnected subsystems. Ecological modernization (E) is impossible without investments in innovation (I), and social sustainability (S) depends on the quality of management decisions (G). This approach is based on a systems paradigm, in which changes in one subsystem inevitably affect the others, creating either synergy or systemic imbalances.

The research applies the following methods: analysis and synthesis, comparative analysis, systematization, indicator normalization, multicriteria assessment, SWOT analysis, regional typology, matrix modelling, graphical interpretation and generalization. Two methods are especially important for the proposed model: indicator normalization, which brings heterogeneous variables to a common scale, and matrix modelling, which links regional problems with specific policy instruments. The empirical information base relies on Eurostat regional statistics, OECD Regional Well-Being, the World Bank's Worldwide Governance Indicators, the European Environment Agency and open statistical resources (Eurostat, 2024; OECD, 2024a, 2024b; World Bank, 2025a, 2025b).

The integrated regional ESG transformation index is calculated as a weighted sum of four blocks. All partial indicators are first normalised to the [0; 1] interval, which ensures the comparability of environmental, social, governance and investment-innovation parameters.

$$I_{ESG} = 0.30E + 0.25S + 0.25G + 0.20I \tag{1}$$

$$x_{norm} = \frac{x - x_{min}}{x_{max} - x_{min}} \tag{2}$$

Where E is the environmental block, S is the social block, G is the governance block and I is the investment-innovation block; xnorm is the normalised indicator value, x is the actual value, and xmin and xmax are the minimum and maximum values in the set of compared regions.

To operationalize the integral index within this conceptual model, the following system of weighting coefficients is proposed: environmental block (E) – 0.30; social block (S) – 0.25; management block (G) – 0.25; investment and innovation block (I) – 0.20. The justification for these coefficients is that environmental modernization (energy efficiency, decarbonization, adaptation to climate change) is the primary driver of long-term structural changes in the regional economy, while social sustainability and quality of governance are critical conditions for the implementation of any transformation strategies. The investment and innovation block, although a catalyst for change, receives a slightly lower weight, since it is largely derived from the first three components: without a proper environmental, social and institutional climate, investment activity remains limited. The given weights are basic for comparative analysis; In the future, depending on the specifics of the region, they can be adjusted by experts (for example, increasing the weight of the social block for depressed areas or the investment block for regions recovering from conflicts).

To ensure the reliability and validity of the proposed integral index, the following procedures should be applied:

1. Reliability test: Calculation of Cronbach's alpha coefficient for each group of indicators (E, S, G, I) in order to confirm their internal consistency.

2. Sensitivity analysis: As mentioned above, varying the weighting coefficients to check the stability of the results.

3. Convergent validity test: Comparison of the obtained index values with the results of other well-known indices, such as the OECD Regional Well-Being or the Human Development Index at the regional level. A significant positive correlation will indicate that the new index measures similar, but not identical, aspects of development.

4. Discriminant validity test: Verification that the proposed index is not a simple duplicate of, for example, a purely economic indicator (GDP per capita), and provides additional information for decision-making.

For empirical substantiation of the proposed weights, it is recommended to use the method of expert assessments (for example, the Delphi method or the T. Saati hierarchy analysis method) with the involvement of specialists in the field of regional economics, sustainable development and public administration. In addition, to check the stability of the results obtained, it is advisable to conduct a sensitivity analysis, varying the weights within ±0.05–0.10. If the results of the ranking of regions remain relatively stable with such fluctuations, this indicates the robustness of the model. It is also possible to use the principal component method or other statistical methods to determine the optimal weights based on actual data, which will avoid excessive subjectivity.

The isolation of the investment and innovation block (I) as a separate component along with the traditional E, S and G components is fundamental for the regional context. Unlike static assessments, regional transformation requires an assessment of the dynamic potential for change. Investments in "green" projects, cluster development, the level of innovative activity of enterprises and the availability of venture capital are key indicators of whether the territory is able not only to maintain the current state, but also to carry out a structural transition. Thus, the block (I) acts as a catalyst that transforms environmental, social and managerial prerequisites into real economic shifts.

An important aspect is the correct interpretation of the direction of influence of indicators. For stimulants (indicators whose increase is desirable, for example, the "share of renewable energy sources", and "employment level"), the above formula is applied without changes. For destimulators (indicators whose decrease is desirable, for example, "CO2 emissions", "unemployment level"), it is necessary to first perform their inverse transformation. To process extreme values (emissions), which can significantly distort the results, it is recommended to apply the

Winsorization method (replacing values that go beyond the 5th and 95th percentiles with the corresponding limit values) or use the median and interquartile range for standardization.

Possible data sources include Eurostat regional statistics, OECD Regional Well-Being, World Bank, Worldwide Governance Indicators, the European Environment Agency, national statistical services, regional development strategies, open budgets, enterprise reports, and investment passports of communities. Table I presents the logic of ESG integration into regional economic policy. It shows that each ESG block has not only analytical but also managerial meaning.

Table I
Measurement model results

ESG block	Regional meaning	Examples of indicators	Expected governance result
E - environment	Decarbonisation, resource efficiency, climate adaptation	energy intensity, renewables, air quality, waste	reduced environmental risks and costs
S - social block	Human capital, inclusion, quality of life	employment, education, access to services, safety	stronger social cohesion
G - governance	Transparency, accountability, stakeholder participation	open budgets, consultations, digital services	higher trust and investment quality
I - investment	Capital for modernization and innovation	green projects, clusters, innovative enterprises	structural renewal of the economy

Source: Compiled by the author based on Eurostat, OECD, European Commission and World Bank

To ensure the operationalization of the model, the following list of indicators is proposed, grouped by blocks:

1. Environmental block (E): Energy intensity of GRP (kg of oil equivalent/1000 euros of GRP); share of renewable energy sources in total energy consumption (%); CO2 emissions per capita (tons); air quality index (annual average); generation of solid waste per capita (kg); share of recycled waste (%).

2. Social block (S): Employment rate of the population aged 20-64 (%); poverty or social exclusion rate (%); share of the population with higher education (%); crime rate (number of crimes per 1000 people); availability of hospital beds (per 1000 people); average life expectancy (years).

3. Governance block (G): Local budget transparency index (scores); share of administrative services available online (%); level of trust in local authorities (according to sociological surveys, %); availability and quality of the regional development strategy (expert assessment); corruption perception index at the regional level (adapted from the CPI).

4. Investment and innovation block (I): Volume of capital investments per capita (euro); share of investments in ”green” projects (%); number of innovatively active enterprises (% of the total); number of patent applications (per 1 million people); presence and activity of industrial parks or clusters (number of active ones).

All indicators should be collected from open statistical sources, such as Eurostat, national statistical services, regional departments of statistics, as well as from administrative registers and open-data of local governments. A unit of measurement is defined for each indicator, which ensures its unambiguous interpretation and the possibility of comparison between regions.

Results

Given that this study did not conduct an empirical ranking of specific territories based on statistical data, but rather developed a conceptual analytical model for assessing the ESG maturity of regional economic systems, this section should be considered as a presentation of the proposed approach, its structural elements and operating logic.

As a demonstration of the operational suitability of the model, we present a conditional example of calculating the integral index for two hypothetical regions corresponding to different types. Let us assume that Region A (innovative-green) has the following normalized indicators: E=0.8; S=0.7; G=0.9; I=0.6. According to Formula (1), $I_{ESG}(A)$ = 0.30×0.8 + 0.25×0.7 + 0.25×0.9 + 0.20×0.6 = 0.760. For Region B (industrial-modernization) with indicators E=0.4; S=0.5; G=0.3; I=0.7, the index will be: $I_{ESG}(B)$ = 0.30×0.4 + 0.25×0.5 + 0.25×0.3 + 0.20×0.7 = 0.460. This conditional calculation demonstrates that the model not only allows for quantitative comparison of regions, but also identifies critical problem blocks (for example, the management block G=0.3 in region B), which can be serve as the basis for prioritizing policy instruments.

Accordingly, instead of traditional empirical results, the author’s conceptual framework, formed on the basis of a synthesis of international methods, is presented here, which determines the composition of indicators, the typology of regions and the matrix of management decisions. Such a construction of the section is a necessary stage before further empirical verification of the model using data from specific regions.

The findings show that the ESG approach can function as an integrator of regional transformation because it connects strategic, investment and operational levels of governance. Under this logic, a region is assessed not only as a territory of production or consumption but as an

integrated system in which environmental quality, human capital, institutional capacity and innovation potential mutually reinforce - or constrain - development (European Commission, 2019; OECD, 2020). Figure 1 summarizes this logic through a transition from environmental modernization to social resilience, governance quality and structural economic renewal.

Fig. 1 *Conceptual scheme of regional ESG transformation*
Source: Developed by the author

The proposed model assumes that regional ESG maturity is formed not by separate environmental or social initiatives alone, but by the degree of consistency between policy priorities, financing arrangements, governance practices and monitoring mechanisms. It is precisely this consistency that determines whether ESG becomes an instrument of genuine modernization or remains a declarative framework. For example, a region may have a green development strategy, but without transparent project selection and accessible performance indicators, such a strategy does not create a full ESG effect.

Table II
Data sources for assessing regional ESG maturity

Block	Main data sources	Level of use	Advantages	Limitations
Environmental	Eurostat, EEA, national environmental registers	NUTS/region/municipality	comparability and regularity	not all indicators are locally available
Social	OECD Regional Well-Being, national statistics	region/city	quality-of-life orientation	some data have time lags
Governance	WGI, open budgets, regional strategies	country/region/municipality	institutional quality assessment	difficulty of subnational detail
Investment	investment profiles, corporate reporting, grant registers	region/cluster	connection with real projects	risk of incomplete open data

Source: systematized by the author.

The environmental block of the model includes energy efficiency, the share of renewables, pollution, waste management, climate risks and environmental investment. The social block covers employment, access to services, education, safety and inclusion; the governance block covers openness, accountability, the quality of strategic documents and digitalization; the investment-innovation block includes green projects, entrepreneurship and innovation activity (European Environment Agency, 2024; Eurostat, 2024; OECD, 2024a, 2024b; World Bank, 2025a). Importantly, these blocks should not be considered in isolation: a weakness in one of them reduces the overall resilience of the regional system.

To ensure terminological consistency between the text description and the tabular data, this study establishes the following unified classification of six types of regional economic systems according to their ESG profile: innovation-green, industrial-modernization, agricultural-resource, urban-service, crisis-restructuring (this type unites territories with a high level of vulnerability and those in the post-conflict or depressed state, therefore the term crisis-restructuring is used in the table) and border-integration (which have transit and logistics potential, are designated as border-integration in the table). The use of these six unified categories ensures the correct comparison of descriptive characteristics in the text with analytical data in Table III.

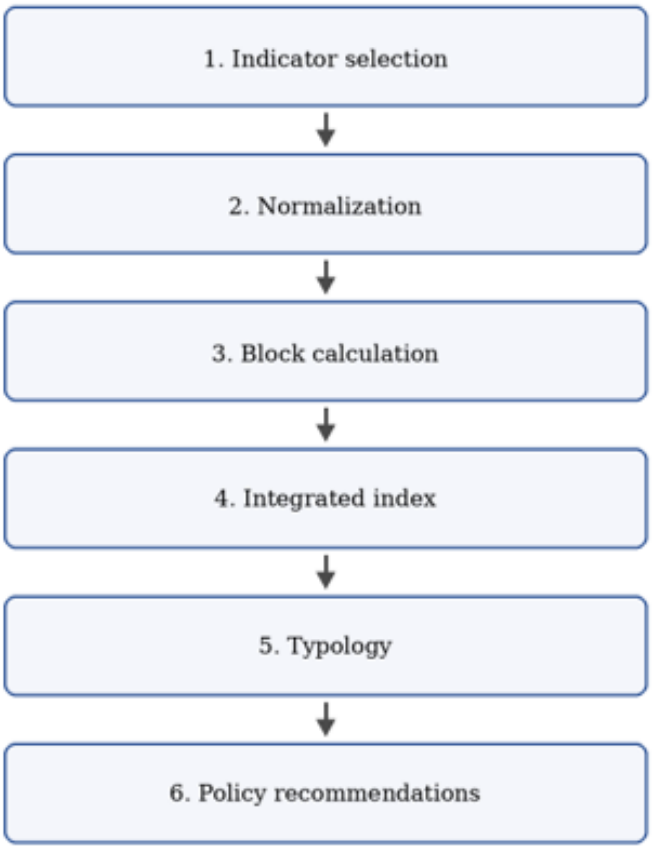

Fig. 2 *Algorithm for assessing regional ESG maturity*
Source: developed by the author

The generalization of the results makes it possible to identify several types of regional economic systems according to their ESG transformation profile. These include innovation-green, industrial-modernization, agrarian-resource, urban-service, transit-logistics and vulnerable regions. This typology is not claimed to be universally rigid; however, it is useful for selecting policy priorities and financing instruments. Its practical advantage is that it does not compare all territories according to the same template but takes into account their economic specialization, resource base, institutional capacity, and social risks.

Table III
Typology of regional economic systems by ESG profile

Region type	Strength	Key ESG risk	Transformation priority
Innovation-green	universities, services, technology	unequal access to benefits	green clusters and innovation
Industrial-modernization	production base and labour skills	high energy intensity and emissions	industrial decarbonisation
Agricultural-resource	land and biological resources	water and soil vulnerability	sustainable land use
Urban-service	concentration of human capital	transport, housing, air quality	smart urban infrastructure
Crisis-restructuring	recovery potential	damaged infrastructure and employment	reconstruction and social reintegration
Border-integration	logistics and cross-border links	institutional fragmentation	European cooperation networks

Source: author's typology

The proposed typology is conceptual and requires empirical validation. To confirm it in practice, it is advisable to apply methods of multivariate statistical analysis, in particular cluster analysis (for example, the k-means method or hierarchical cluster analysis) based on the normalized values of the E, S, G and I block indicators for each region. The result of such an analysis will be an objective classification of regions, which can be compared with the theoretically proposed typology, thus confirming or correcting it.

The proposed framework suggested that ESG transformation follows a different logic for different types of regions. Industrial territories need energy efficiency, production modernization, emissions control and reskilling policies; agrarian territories require natural resource protection, water management and support for local processing; urbanized territories should prioritize transport sustainability, air quality, housing infrastructure and citizen participation in decision-making. Thus, the same ESG framework should be filled with different content depending on the real profile of the territory.

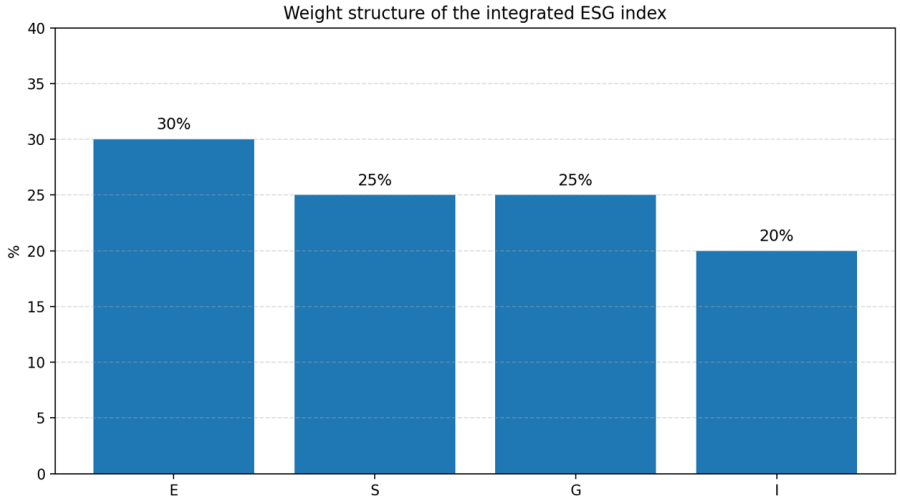

Fig. 3 *Figure 3. Weight structure of the integrated regional ESG transformation index*
Source: developed by the author

It is important to note that the proposed matrix of regional ESG solutions (Table IV) is a universal toolkit that can be applied to different types of regions; however, the priority of choosing specific tools depends on the typological group (Table III). For example, for industrial and modernization regions, the key problem area is high energy intensity, so the main tool will be energy audit and modernization of enterprises; for urban and service territories, transport and air quality problems come to the fore, which requires the implementation of "smart" urban infrastructure tools; for crisis and restructuring regions, the key tool is reconstruction and social reintegration. Thus, Table IV offers a set of possible tools, and Table III determines, which of these tools are priorities for each specific territory, thereby ensuring the flexibility of the model and its adaptability to real conditions.

A practical outcome of the study is a matrix of regional ESG solutions linking a problem, a policy instrument, an expected effect and a monitoring indicator. Its use makes it possible to move from general declarations to an instrumentally defined regional policy in which ESG becomes the basis for project selection and for assessing their contribution to territorial transformation. The matrix may also be useful for communication with stakeholders because it makes the connection between a problem, a policy response, and an expected result more transparent.

Table IV
Matrix of regional ESG solutions

Construct / dimension	Items	Loading range	Cronbach α	CR	AVE
Green recruitment (eco-skill focus)	3	.82–.88	.89	.93	.72
Green training (digital integration)	4	.79–.91	.92	.94	.78
Green rewards (community impact)	3	.84–.89	.88	.92	.75
EGB – eco-initiatives	3	.81–.88	.87	.91	.72
EGB – eco-civic engagement	4	.82–.89	.90	.93	.74
EGB – eco-helping	3	.83–.88	.89	.92	.73
EIP – green process innovation	6	.80–.89	.93	.95	.76
EIP – green product/service innovation	6	.81–.88	.91	.93	.74

All reported loadings were significant at p <.001.

Institutional transparency plays a special role. The ESG approach cannot be reduced to environmental projects or social initiatives alone if trust, open data, clear procedures and effective accountability mechanisms are absent. It is the governance dimension that creates the conditions under which investment in sustainable development becomes systemic rather than sporadic (EFRAG, 2024; World Bank, 2025a) European Parliament & Council of the European Union, 2022;. In this sense, governance quality is not an auxiliary element of ESG but one of its central preconditions.

Fig. 4 *Management cycle of regional ESG transformation*
Source: compiled by the author

Discussion

The results obtained correspond to the approaches used by the OECD and Eurostat, considering regional development as a set of interrelated characteristics of the well-being of the population, the efficiency of resource use and the quality of the institutional environment. At the same time, the proposed model complements these approaches with ESG principles, which makes it possible to use it not only to assess the state of regions, but also to justify decisions in the field of regional policy and investment planning (Eurostat, 2024; OECD, 2024a, 2024b; World Bank, 2025a). This is not about creating a new set of indicators, but about their systematization taking into account the needs of regional management and planning.

Comparing the proposed model with existing indices, such as the OECD Regional Well-Being or the Eurostat SDG Indicators, reveals both common features, and fundamental differences. What is common is the recognition of the multidimensionality of regional development and the use of a wide range of indicators. However, unlike the aforementioned approaches, which are mostly monitoring and comparison tools, the proposed model integrates ESG logic, which implies a direct connection between the assessment of the state and the matrix of management decisions. In addition, the separation of the investment and innovation block (I) allows the model to assess not only the current state, but also the potential of the region for transformation, which makes the model practically more valuable for developing development strategies.

Although this work focuses on the conceptual development of the model, its operational suitability needs to be confirmed on the basis of real data. A promising direction is to test the proposed integral index on a sample of EU regions (NUTS-2 level) or regions of Ukraine. Such testing will allow researchers to:

- Check the availability and completeness of the necessary statistical information;
- Calculate the index for each region and build rankings;
- Verify the proposed typology on the basis of actual data.

This will be the next logical step of the research and will ensure the transition from a theoretical model to a practical policy tool.

The choice of weighting coefficients remains one of the most controversial issues. Using the same weights for all regions facilitates their comparison, but may not take into account differences between territories. For example, for industrially developed regions, environmental indicators may be more important, while for peripheral territories or regions with long-standing socio-economic problems, social and management characteristics may be decisive. Given this, when using the model in practice, it is advisable to use basic weights with the possibility of adjusting them according to the specifics of a particular region.

Certain difficulties also arise due to the limited availability of regional statistics. Some of the indicators required for ESG assessment are not collected systematically at the subnational level, and individual data are generated using different methodologies. This reduces the possibilities of meaningful comparison between regions. In further research, it is advisable to expand the list of available indicators and adapt the methodology to the specifics of individual countries and territories (Eurostat, 2024, 2025a, 2025b). The development of open data systems requires special attention, since their insufficiency significantly limits the possibilities of a full assessment of ESG risks at the regional level.

To illustrate the model's operation and demonstrate its operational capability even in the absence of a full empirical base, we present a conditional example of calculating the integral index for two hypothetical regions. Let Region A (innovative-green) have the following normalized indicators: E=0.8; S=0.7; G=0.9; I=0.6. Substituting the values into Formula (1) with the proposed weights, we obtain: $IESG(A) = 0.30\times0.8 + 0.25\times0.7 + 0.25\times0.9 + 0.20\times0.6 = 0.240 + 0.175 + 0.225 + 0.120 = 0.760$. For Region B (industrial-modernization) with indicators E=0.4; S=0.5; G=0.3; I=0.7: $IESG(B) = 0.30\times0.4 + 0.25\times0.5 + 0.25\times0.3 + 0.20\times0.7 = 0.120 + 0.125 + 0.075 + 0.140 = 0.460$. This conditional calculation demonstrates that the proposed index allows not only to quantitatively compare the level of ESG maturity of regions, but also to identify problem blocks (in Region B, the management indicator G=0.3 is critically low, which suggests the need for the priority implementation of instruments to increase institutional transparency). This approach illustrates the practical suitability of the model for diagnosing and planning regional policy even before conducting a full-scale empirical study.

For Ukraine, the importance of the ESG approach is growing in view of the tasks of post-war reconstruction and further integration into the European economic space. Regions that, during reconstruction, will take into account not only the restoration of damaged infrastructure, but also increasing energy efficiency, compliance with environmental requirements, strengthening social cohesion, and increasing transparency of governance will have better prerequisites for attracting investments and forming a sustainable economic base for the future (European Commission, 2019; OECD, 2020). Therefore, ESG should be considered as one of the approaches to organizing the recovery process, in which reconstruction decisions are aimed not only at eliminating the consequences of destruction, but also at reducing previously accumulated economic, social, and environmental problems.

This study has a number of limitations that should be considered when interpreting the results and further using the model. First, the main limitation is the lack of full empirical validation based on real statistical data for specific regions, which makes the model a conceptual tool at this stage. Second, there is a problem of data availability and comparability of regional data: not all indicators needed to calculate the index are systematically collected at the subnational level, and the methodologies for their collection may differ between countries. Third, the choice of weighting factors carries an element of subjectivity, despite the proposed methods for their justification. Finally, the model assumes a certain level of institutional capacity for data collection and implementation of ESG-oriented decisions, which may be limited in some regions.

Conclusions

ESG approaches can be used as one of the means of developing and updating regional economic systems, as they allow researchers and policymakers to simultaneously take into account economic, environmental, social and managerial aspects. The article develops an analytical model for assessing the ESG maturity of regions, identifies the main sources of necessary data, proposes a typology of regions and forms a matrix of possible ESG solutions. The results obtained can be used in the preparation of regional strategies, the determination of priority projects, assessing the effectiveness of policies and creating favorable conditions for attracting investments. Further work involves testing the proposed model using data from specific regions, specifying the weights of individual indicators and expanding the list of data that can be regularly used to assess the state of regions.

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