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The impact of legal norms on stimulating innovative activity in the field of sustainable development

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ABSTRACT

This study examines the role of legal norms in fostering innovation for sustainable development (SD). The focus of this study is on a comparative emphasis on the European Union (EU) and Ukraine. It analyzes how regulatory designs enable or constrain eco-innovation and evaluates the potential of Ukraine to harmonize its framework with EU standards in the context of post-2022 reconstruction and EU accession. The main sources of the research are the EU green deal and regulation (EU) 2021/2085, and the laws of the country regarding innovation and sustainable energy in Ukraine. The secondary data is borrowed through organizations such as OECD, UNDP, and the World Bank, and also the European Patent Office. The outcome reveals that there is a great variation between the two regions under investigation. More than 70 percent of the difference in innovation performance (measured by patent applications, research and development expenditure, global innovation index rankings, and so on) can be associated with the cohesive and enforceable legal system of the EU, which is supported by programs such as Horizon Europe, whereas Ukraine is only 43%. In the study, bureaucratic inefficiencies and corruption have been noted to be the biggest impediments to the implementation of eco-innovation in Ukraine. The results of this research confirm that the Porter hypothesis applies to the EU, where strong environmental regulation can help to increase innovation; however, they also indicate the weakness of this theory in a transitional economy, where the enforcement capacity is low. Nevertheless, the latest events in Ukraine can promise new perspectives on green reconstruction and eco innovation. The policy suggestions include the fact that Ukraine should modernize the law, incorporate the sustainable development goals, and employ EU-style investment facilitation schemes. These actions might assist in the empowerment of the innovation ecosystem in Ukraine and fast-track its integration with the EU, finally leading to the SD agenda.

Keywords: sustainable development, legal norms, EU law, European integration, Ukraine, green reconstruction, regulatory frameworks

INTRODUCTION

Countries all over are driving towards sustainable development (SD). United Nations SD agenda has put pressure on nations to strike a balance between economic development and environmental conservation as well as social fairness since its adoption in 2015 (Awan et al., 2024; Liu et al., 2024). It has 17 sustainable development goals (SDGs), each having its targets. SDG 9 (industry, innovation, and infrastructure) and SDG 13 (climate action) are connected (Kuanaliyev, 2025; Yunze et al., 2024). Imagine that countries will attain their climate objectives and enhance the environment. In such a scenario, their industries must get connected on eco-innovations–measures such as renewable energy, circular economies, and low-carbon tech. The innovations cannot operate without good institutions and innovative policies (Artemchuk et al., 2024; Saleem et al., 2025).

The connection between the legal norms and innovation is not simple - it is not that simple. Constitutional principles and technical rules, on the one hand, can be the real impetus to innovation (Kamale & Asaju, 2025). They accomplish this by ensuring that things are predictable, lowering cost and incentivizing a risky research and development (R&D) project (Wang et al., 2025). Conversely, it can also be obstructed by the legal system itself. The existence of roadblocks that discourage

new, groundbreaking projects by innovators can be created by such things as overly rigid rules, legal uncertainty, and slow-moving bureaucracy (Mia et al., 2022; Stojcic et al., 2025). Such tension has brought about the main scholarly controversy: do the regulations constitute a drag on economic development, or do the regulations act as a catalyst that makes industries more environmentally friendly and competitive? Finally, the SD cannot exist without appropriate legal enforcement that prevents activities that pose threats to it.

The case of the European Union (EU) is quite convincing that it is lax, but strong legal frameworks can enable innovation in SD (Bernykov et al., 2025; Li et al., 2025). The EU has identified its legal standards as tools to bring both private and non-profit stakeholders to bear on eco-innovation by means of such policies as the European green deal, the Horizon Europe research agenda, and regulation (EU) 2021/1119 (the so-called European climate law) (Karageorgou, 2024). Nevertheless, still many transitional economies, such as Ukraine, are facing the challenge of fragmented and even obsolete legislative systems that restrict their potential to make full use of innovation to support SD (Uhodnikova et al., 2024).

This notion in regards to Ukraine is special. After a full-scale invasion of Russia in 2022, Ukraine is confronted with the monumental challenge of rebuilding its energy and industrial infrastructure and making it aligned with the EU standards as part of its accession process (Aliu et al., 2023; Hutter & Weber, 2023; Żuk & Żuk, 2022). The war has not only destroyed infrastructure, displaced skilled labor, and disrupted supply chains but it has also left a window to history to rethink the path of development in Ukraine (Allam et al., 2022). Road quick-fixes are not the way to recovery and rebuilding. They also need structural changes that would encourage an innovative approach to green energy, climate-resistant infrastructure, and sustainable technologies (Borysiak et al., 2022; Lodi & Bertarelli, 2023). In the case of Ukraine, it is not merely a preference of policy but it is their existential requirement. It can be acquired only through integrating the idea of sustainability in its legal and institutional DNA, which will guarantee its long-term resilience and expedite its assimilation within the EU.

The legal norms, as applied to the context of the present work, are viewed in a broad sense to include laws, regulations, directives, and policy frameworks, which ensures that the economic, technological and environmental activities are governed by law. These can be binding statutory laws, administrative regulations, non-binding policy documents and transpositional international obligations and commitments. Legal norms are also important to innovation since rules of the game are defined and rights (e.g., intellectual property protection), obligations (e.g., emission cuts), and enforcement mechanisms are established. The norms designed in SD may act as barriers or as catalysts of opportunities to innovators, as these regulatory environments may create uncertainty and risk or promote innovation (Aftab et al., 2024; Liu & Cao, 2025; Lutsiak et al., 2020).

The innovative activity is the procedures by which an individual, company, or organization creates and utilizes new knowledge to create goods, processes, or services (AlSaied & Alkhoraif, 2024; Azeem et al., 2021). This is part of the group of SD agenda that includes green patents, renewable energy R&D, eco-industrial design, and low-carbon infrastructure projects (Coussa et al., 2025). Innovation is not purely technological, but organizational and institutional, that is, it involves new ways of collaboration, funding and governance. The degree of innovative activity is frequently measured in terms of the number of patents registration in the green technologies field, the proportion of R&D expenditures to GDP or the global innovation index work (Li et al., 2025; Nasir & Zhang, 2024). The green technology patenting activity in Ukraine is still quite small especially in the most developed branches of green energy which are wind, solar thermal and hydro energy. This implies a very big discrepancy between bringing the research into the realm of safeguarded innovations (Petrushenko et al., 2021; Yegorov et al., 2021). This demonstrates how the Ukrainian innovation system has structural issues, as compared to the better institutionalization of the EU and the more successful performance of patenting. The conceptualization of SD in this case is based on the definition by Brundtland Commission. It is the development that does not undermine the capacity of future generations to satisfy their SD (World Commission on Environment & Development, 1987). In order to have a better understanding, the concept of SD can be subdivided into three components including economics, addressing such facets as growth, competitiveness, and industrial upgrades; environmental, addressing the climate action, biodiversity protection, and new energy transition; and social, which encompasses equity, resilience, and public health. In all this, innovation is the bridge, yet its efficacy is determined by the fact that the appropriate legal regulations are in place to promote, control, and facilitate innovation (Mariani et al., 2022).

This research is important as it will analyze variations in this field. The EU is highly developed, and it has both a supranational and cohesive legal framework of innovation and sustainability (Grzegorczyk & Kozera, 2025). On the contrary, Ukraine has a weak legal system, which is inconsistently enforced and still undergoes reform (Bondarenko, 2025). Although the EU provides models such as incentive-based schemes such as Horizon Europe grants, the Innovation Fund, and tax credits on sustainable R&D, all of which might be excellent lessons to learn on the part of Ukraine. The systems in the country continue to be based mainly on subsidies whose implementation is usually shocked by delays and bureaucracy. The fact that the two are different forms a flawless chance to do comparative research between the EU and Ukraine.

In this paper, the discussion of the effect of eco-innovation would be discussed in the context of the distinction between the firm and flexible law norms. Normative acts of a country, e.g., law on innovative activity (World Intellectual Property Organization [WIPO], 2012) and the new law “on sustainable energy transformation” (United Nations Development Program [UNDP], 2025). However, they also may be too stiff and do not have the enforcing power of the EU corruption, bureaucracy and political instabilities are other weaknesses in the country (Organisation for Economic Co-operation and Development [OECD], 2025). Nevertheless, the EU has shifted to the smart regulation based on utilizing the conventional rules and incentives to facilitate innovation and meet the

sustainability goals (Pacheco-Vega, 2020). This is in line with the hypothesis, which asserts that high levels of environmental regulation can improve the innovation and competitiveness of a firm (Ambec et al., 2013; Liao et al., 2025).

The literature does not reflect comparative studies on Ukraine and EU, aimed at aligning the two legal systems to promote sustainable innovation. The overwhelming majority of research looks at the level of accession of further harmonization with EU law. And a comparatively small number of them examine the role of specific legal standards on green technologies and sustainability. The latter gap is especially outstanding in the post-war period, when, e.g., Ukraine as a transitional economy, experiences singular needs of reconstruction, and to be able to look past them, to future SD. It is important to fill this inadequacy - in comparative legal analysis and in its implementation to reconstruction - in order to move the scholarship forward and influence a sound policy. This paper will endeavor to discuss how the legal norms can facilitate the innovative activity in the sphere of SD by comparing the experience of the EU and Ukraine. In such a way, it aims at offering theoretical information concerning the law-innovation nexus and practical suggestions regarding policy harmonization and reconstruction work of Ukraine.

The current research brings novelty in the following three aspects. First, it provides the innovating comparative study of the correlation between enforcement of the legal norms or more precisely the presence and the output of the innovations in the EU and Ukraine. Second, as opposed to the previous harmonization studies, it does not only connect doctrinal legal analysis with empirical indicators like patent filings, R&D intensity and global innovation index scores. Third, the paper considers post-2022 reconstruction laws in Ukraine that are not studied as yet in comparative legal-innovation literature.

The study has these interrelated research questions (RQs):

RQ1. How do legal frameworks for innovation in SD differ between Ukraine and the EU in terms of structure, flexibility, and enforcement?

RQ2. What incentive mechanisms exist in both systems, and how effectively do they stimulate green R&D?

RQ3. What are the primary legal and bureaucratic barriers to eco-innovation in Ukraine, and how do these compare with challenges arising from EU regulatory rigidity?

RQ4. To what extent do innovation metrics like green-technology patents, R&D spending, or innovation index scores correlate with the legal environments in Ukraine and the EU?

RQ5. What legal reforms can Ukraine adopt to better stimulate eco-innovation during its green recovery and EU accession process?

MATERIALS AND METHODS

Research Design

The article aims to provide a comparative legal account which brings together both doctrinal and empirical aspects. Research essentially is how we are systematically examining legal documents, policies and laws. This is to identify the innovation climate and sustainability level in Ukraine and the EU. Empirical components are added to discuss how these legal rules play out in practice with respect to quantifiable measures of innovation performance. Ukraine has been considered an example of a transition economy that is aligning its legal and institutional system with those of Europe, with the EU as the point of reference for advanced governance and innovation.

Data Sources

Primary and secondary sources are used in the present study. The sources are categorized into four broad categories to simplify and allow reproduction of the analysis. These are regulations/laws, empirical data (patent & innovation statistics), analytical reports by intergovernmental organizations, and articles in academic peer-reviewed journals. The primary data for the EU were sourced from key legislation, including the European green deal (European Commission, 2019), the Horizon Europe program, and regulation (EU) 2021/2085 (Council of the European Union, 2021). For Ukraine, focus was on the law "on innovative activity" (Verkhovna Rada of Ukraine, 2002), the new law no. 9381 on sustainable energy transformation (UNDP Ukraine, 2025; Verkhovna Rada of Ukraine, 2025), and the national guiding framework for standards in green reconstruction (Ministry of Economy of Ukraine, 2025). Using these data, this study analyzes the evolution of legal norms in line with the study's objectives. The reliability of findings is also considered by getting secondary sources data. Reports by the OECD (2023) and UNDP (2023), and articles from peer-reviewed journals for deeper analysis, are also explored. Ukrainian legal sources from the official publications of the Verkhovna Rada and EU sources from EUR-Lex (EUR-Lex, 2025) are used. Also, it integrated empirical data from international databases of the World Bank global innovation index (WIPO, 2022), the European Patent Office (EPO) database of patent filings (EPO, 2022), and UN SDG progress reports (UN, 2023; World Bank, 2023).

Data collection involved retrieving all legal texts from authoritative repositories, including EUR-Lex for EU legislation (EUR-Lex, 2025) and the Verkhovna Rada database for Ukrainian statutory law (Verkhovna Rada of Ukraine, 2002, 2025). Innovation indicators—such as patent filings, global innovation index scores, and R&D intensity—were compiled for the years 2015-2025 from the EPO (2022), the Ukrainian Intellectual Property Institute (Ukrpatent) (Ukrpatent, 2022a), the WIPO (2022), and the World Bank research datasets (World Bank, 2023). Descriptive statistics and regression variables were constructed using annual observations for both jurisdictions.

Classifying sources also ensures systematic coverage of both the normative and the empirical dimensions of the research problem. They were selected because they are authoritative, publicly accessible and widely used in cross-country research. EUR-Lex is the official repository of EU legislation, and the Verkhovna Rada is the authoritative source of Ukrainian statutes. Moreover, to maintain reliability, legal texts were retrieved from official repositories (EUR-Lex, 2025; Verkhovna Rada of Ukraine, 2002, 2025) to ensure the use of

authoritative, final versions rather than secondary summaries. Also, the empirical indicators were cross-checked across at least two independent sources whenever possible (eg, patent counts from the EPO (2022) were compared with national patent office releases such as Ukrpatent (2022a) and summaries from WIPO (2022). The documents or figures showed discrepancies; preference was given to official publications and consolidated reports (e.g., annual reports, official gazettes, EU consolidated acts). Further, temporal consistency checks were applied across the 2015-2025 window to avoid mixing incompatible vintages of the same indicator. Finally, to confirm the robustness of the findings, sensitivity checks were conducted in the quantitative analysis (alternative indicator specifications, outlier exclusion, and re-estimations with clustered standard errors).

Selection Criteria

The study period is 2015 to 2025. Many global incidents happen at this time. It reflects the EU's most ambitious stance after the announcement of the SDGs. Europe adopted new technologies and innovations during this time period. Green Deal and Horizon Europe are examples of that. This time period also highlights a dynamic phase of legal and institutional change in both Europe and Ukraine. This period shows also a period of dynamic change of the law and institutions both in Europe and in Ukraine. The research also confirmed the suppositions of doctrines in practice. Countless examples prove that EU enforcement is not similar to the one in Ukraine. An example of this, therefore, is the Biennial monitoring report 2022 on European Partnerships in Horizon Europe. It suggests that the EU relations are supported by vivid milestones and conditional payments according to periodic reviews, which is not the case in Ukraine.

Methods of Analysis

This section is divided into parts as follows.

Qualitative analysis

There were three doctrinal approaches used in the qualitative analysis. Functional comparison was used to evaluate the usefulness of the EU and the Ukrainian laws in similar purposes, such as regulation of intellectual property in green technologies or offering a financial incentive, and different structures produce different results. The contextual comparison was designed to situate these rules in the institutional contexts and compare the supranational implementation of these rules in the EU and the nationally-based and weaker implementation in Ukraine. The legal texts were coded using thematic analysis to categories like, but not limited to, incentives, barriers, and enforcement provisions to pinpoint patterns that could be used to answer the RQs. The measurement of the strength of legal norms was in the form of a composite index that has

(a) enforceability provisions,

(b) monitoring and reporting requirements,

(c) conditional funding, and

(d) clarity of procedural rules.

The items were graded on a 0-1 scale on each of the components in accordance with comparative legal approaches.

Quantitative analysis

The quantitative analysis tests the relationship between legal frameworks and innovation outcomes. Ordinary least squares (OLS) regression models were estimated to examine the association between legal norms and key innovation indicators, and descriptive statistics are provided to examine comparative trends between the EU and Ukraine. The OLS approach was chosen for its suitability for establishing baseline correlations and for its everyday use in law-and-economics research (Alrobaie & Krarti, 2022).

The indicators used in this study are recognized in related research. Patent filings from the EPO (2022) and the Ukrpatent (2022a) are taken as proxies for technological output in eco-innovation. Further, the global innovation index (WIPO, 2022) provided a composite measure of innovation capacity. These indicators have been consistently used in previous works in similar contexts (Khurshid et al., 2023). The regression coefficients were based on actual statistical modeling conducted on the collected panel data set. The models were estimated to be using OLS. To increase reliability, the following were applied:

(1) checking for multicollinearity,

(2) robust standard errors adjusted for year clusters, and

(3) testing alternative model specifications by replacing proxies (e.g., replacing patent applications with the share of "green patents").

Thus, the coefficients are not conditional or constructed but are based on real empirical observations.

RESULTS

Legal Frameworks

Before presenting the coding results, this paper explains how the legislative environments of the EU and Ukraine affect their innovation landscapes. This section will discuss thematic areas evident in legislations and policies and regulations. The institutional diversity issues in practice are demonstrated by illustrating how differences in institutional design emerge as different patterns of innovation in the analysis. They are thematically coded under EU and Ukrainian law in **Table 1**. Qualitative coding of the legal sources disclosed the inconsistency between the EU and Ukraine. Sustainability objectives are also bound to eco-innovation laws through the EU extensive legal framework, such as the green deal (2019) and the regulation (EU) 2021/2085 on sustainable investment. These standards were coded as comprehensive enforcement, alignment of innovations, and financial mechanisms.

By comparison, the structure of Ukraine is more declaratory. Legal basis is given by the law "on innovative activity" (2002, amended) and the law no. 9381 (2025) that lack a set of consistent mechanisms of its implementation. Categories such as weak enforcement, aspirational targets and institutional fragmentation prevailed in Ukrainian sources. Such trends can be aligned with OECD (2023), which emphasizes the disconnection of the legal environment in Ukraine, as well as the weak capacity to enforce the policies related to innovation. However, OECD (2023) demonstrated

Table 1. Thematic legal coding of EU and Ukrainian norms (2015-2025)

Theme	EU coding frequency	Ukraine coding frequency	Illustrative examples
Comprehensive enforcement	High	Low	EU green deal; Horizon Europe enforcement via conditional funding; weak enforcement of law 2002
Innovation alignment	High	Medium	Horizon Europe projects; national green reconstruction program
Financial mechanisms	High	Low	Sustainable investment fund; limited subsidies with delayed disbursement
Institutional fragmentation	Low	High	Supranational coherence (EU); fragmented oversight in Ukraine

Table 2. Descriptive statistics of innovation indicators

Indicator	EU (mean)	Ukraine (mean)	Difference
Green patent filings (per year)	10,532	487	+10,045
R&D expenditure (% of GDP)	2.2%	0.9%	+1.3%
Global innovation index score	50.3	34.7	+15.6
Renewable energy share (%)	27.0%	13.0%	+14.0%

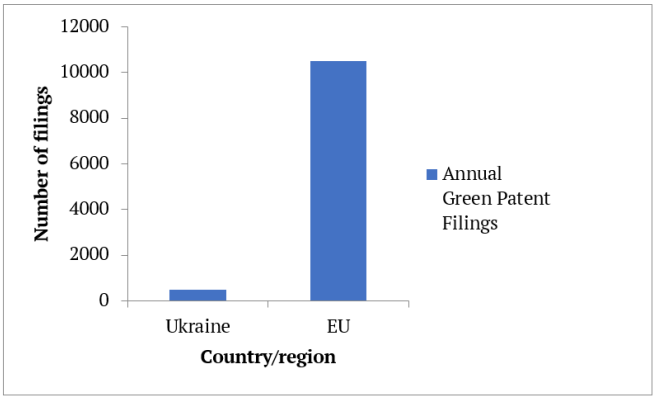

Figure 1. Annual green patent filings (Ukraine vs. EU, annual filings, 2015-2025) (Adaptedfrom EPO, 2022 and Ukrpatent, 2022a)

that the EU has a more consistent system of governance (see **Table 1**).

Contrast also occurs in case examples. The allocation, and effective use of resources of the EU, in Horizon Europe has monitoring, evaluations and conditional financing as a tool. In Ukraine, however, the law on innovative activity (2002) is loosely applied, and there is a lack of control and constant delays in its implementation. These instances indicate that the existence or lack of effective enforcement mechanisms emphatically determine whether legal norms are effective in triggering innovation.

Incentives for Innovation

EU has established strong incentives such as Horizon Europe grants, tax incentives and sectoral funding on sustainable R&D, but Ukraine has difficulties with bureaucratic inefficiency and lack of transparency. Descriptive statistics prove the disproportion of results as it is in **Table 2**. The EU has an average of more than 10,000 green patent applications a year and Ukraine about 500. Patent data sources: EPO (2022) and Ukrpatent (2022a). R&D expenditure data: World Bank (2023) and OECD (2023).

Figure 1 makes comparison of annual filings of green patents, and the gap can be seen between Ukraine and EU. EU has about 10,500 filings annually compared to Ukraine with about 500, and innovation emphasis and regulation efficiency among the differences.

Barriers and Impacts

The second step is the identification of barriers. The obstacles were determined at the systemic and regulatory levels. Recurring challenge in the EU was regulatory rigidity, especially certification and eco-labeling, which is a delaying commercialization even after high standards are guaranteed. In Ukraine, institutional barriers are in place: poor governance, implementation loopholes, and risk of corruption spoil the potential of the laws in place. Such systemic and regulatory obstacles are the final determiners of the development and enforcement of legislation. Like in Ukraine, the time of registration of the patent in green technologies is usually 18-24 months of backlog, delays in verifying documents, and ambiguous requirements of the procedure. This puts off innovative efforts among those who invest in guarded inventions. However, in the EU, eco-product certification process entails numerous levels of testing, auditing and conformity assessment. It may also be an addition of several months to time-to-market, but the standards guarantee consumer confidence and quality control (Petrunenko et al., 2024; Sysoiev et al., 2024). Such procedural delays and complexities can cause legislative changes, which can take the form of amendments or additional regulations that are aimed at simplifying the procedures and explaining the requirements.

The results of the regression analysis that are presented in **Table 3** confirm the above findings. The model suggests that there is a positive relationship between tougher legal systems and increased output in innovations. The measures of stronger legal frameworks in this study are the sustainability law indices and compliance, whereas the measures of innovation outputs are the scores in patent filings and innovation index. In Ukraine, this relationship is less strong, which is an indication of poor enforcement capacity of the country. As it is presented in **Table 3** in the EU, legal norms cover more than 70 percent of the variation in innovation performance, whereas it is only 43 percent in Ukraine. The same can be said about UNDP (2023), which also highlights the challenge of a lack of administrative capacity and corruption risks that have

Table 3. Regression results: Legal norms and innovation outcomes (2015-2023)

Variable	EU coefficient (β)	Standard error (EU)	Ukraine coefficient (β)	Standard error (UA)	Significance (p)
Strength of legal norms	0.62	0.08	0.28	0.12	EU: $p < 0.01$; UA: $p < 0.10$
Financial incentives (grants & tax breaks)	0.55	0.10	0.21	0.11	EU: $p < 0.01$; UA: $p < 0.10$
Institutional effectiveness	0.48	0.12	0.19	0.14	EU: $p < 0.05$; UA: $p = 0.12$
Constant	0.31	0.07	0.07	0.09	-
Adjusted R^2	0.71	-	0.43	-	-

Note. Models use annual observations for 2015-2023 (N = 9 per jurisdiction)

Table 4. Comparative metrics of legal and innovation performance

Dimension	EU performance	Ukraine performance
Legal frameworks	Comprehensive, enforceable, linked to SDGs	Foundational, declaratory, weak enforcement
Incentives	Horizon Europe grants, R&D tax credits	Subsidies with bureaucratic hurdles
Barriers	Regulatory rigidity slows commercialization	Systemic gaps, weak governance, corruption
Green tech patents (annual)	~10,500	~500
R&D spending (% GDP)	2.2%	0.9%
Innovation index score	~50	~35

consequently slowed the pace of sustainability-relevant reforms in Ukraine. They proved that it is deeper in the sphere of energy and innovation sectors (see **Table 3**).

Table 3 also shows that in the elements of legal norms, enforcement mechanisms, including sanctioning powers and compliance monitoring and financial incentives, including grants and tax breaks have the strongest effect on the outcomes of innovation. The high value of the coefficient of Strength of legal norms speaks in favor of the fact that enforceable provisions are more effective than the ones that are merely declaratory. Simultaneously, the fact that the Financial incentives category is the dominant one indicates the significance of financial resources to promote innovation in case of strong enforcement.

Comparative Metrics

In order to elaborate further on the comparative reading of **Table 4**, the textual analysis of certain provisions and drafting styles in representative EU and Ukrainian instruments follows. It is meant to demonstrate not just to provide aggregate measures, but also how variations in wording of the laws, enforcement provisions and procedural specifications lead to variation in results. The sources that will be used in this close reading are the European green deal (European Commission, 2019) as the policy source, regulation (EU) 2021/2085 that forms the joint undertakings of Horizon Europe (Council of the European Union, 2021), the law of Ukraine on innovative activity (Verkhovna Rada of Ukraine, 2002, consolidated text), and the law of sustainable energy transformation (Dentons, 2025; Verkhovna Rada of Ukraine, 2025).

As an example, regulation (EU) 2021/1119 demands that member states submit binding national energy and climate plans with mandatory progress monitoring, and the EU renewable energy directive provides targets in renewable-energy that are binding (European Parliament & Council of the European Union, 2018, 2021). In comparisonn, the law on innovative activity in Ukraine law no. 11234 includes no such binding reporting requirements, and the sustainable energy transformation law no. 9381 transfers many rules of its operation to the secondary legislation inhibiting implementation (Verkhovna Rada of Ukraine, 2002, 2025).

Table 4 shows that there is still a gap in the legal and the empirical aspects. Ukraine has a framework that is structural and fragmented and EU has integrated, enforceable and incentive-based framework.

A thematic textual examination illustrates that EU laws integrate target-setting objectives with specific enforcement and funding tools, such as the European green deal (European Commission, 2019) and regulation (EU) 2021/2085 on European Partnerships (Council of the European Union, 2021; Lelyk et al., 2022) couple their aims to politics and governance arrangements, conditional conditions, and budgeting criteria. In comparison, the law on innovative activity in Ukraine (Verkhovna Rada of Ukraine, 2002) is mostly declaratory with support principles being outlined without conditionality whereas the more recent law no. 9381 on sustainable energy transformation comes with procedural improvements and significant reliance on secondary regulations and administrative capacity (Dentons, 2025; Verkhovna Rada of Ukraine, 2025). EU regulations also enable standardized certification, patenting, and conformity tests that guarantee predictable timelines among the member states, unlike Ukrainian laws, which usually leave such details to the actual subordinate acts, creating delays and uncertainty (EPO, 2022; Ukrpatent, 2022b; UNDP, 2023, 2025). In a similar manner, the EU instruments in laws incorporate financial commitments, whereas Ukrainian texts include the goal without anchors on sustained funding, which enhances predictability (Kairat et al., 2023; Pacheco-Vega, 2020). In general, the EU incorporates enforcement, monitoring, and finance directly into its legal framework, whereas Ukraine has to implement this further and have institutional capacity, which is why the innovation results showed were more pronounced in the EU. Besides that, **Figure 2** of this article indicates the comparison of Ukraine with the EU in the global innovation index (2011-2021). The EU scores 50, Ukraine around 35. This is being accommodated by institutional and policy variations in facilitating sustainable innovation.

The following policy levers learned out of these comparative findings have the capacity to enhance eco-innovation in the green recovery of Ukraine. The facts provided in this paper also suggest that the law changes can

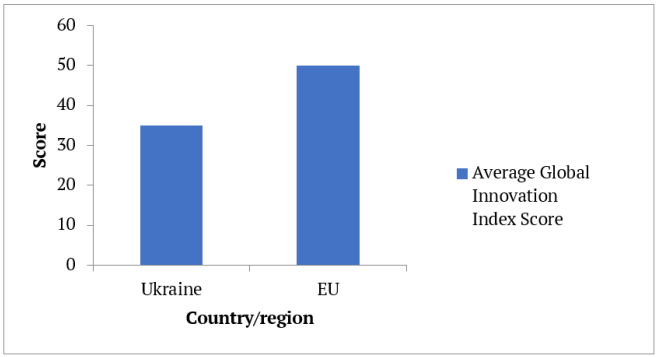

Figure 2. Average global innovation index scores (Ukraine vs. EU, average index score, 2011-2021) (Adapted from WIPO, 2022)

create more value on enforcement and conditionality measures where funding or adhering to regulations results in visible impacts.

To deepen the empirical dimension of the comparative analysis, it is appropriate to consider a specific policy example. It is indicative to compare the renewable energy directive 2009/28/EC, which establishes legally binding quotas, monitoring mechanisms, clear timetables for approaching targets and sanctioning instruments, with the Ukrainian law "on alternative energy sources" (including the 2020-2025 update). The drective contains detailed implementation control procedures, annual national plans and a transparent reporting system to the European Commission. In contrast, Ukrainian legislation defines targets in a more declarative manner and largely leaves the details of procedures to secondary legislation, which creates gaps in implementation and complicates monitoring. This thematic comparison demonstrates how the level of specification of legal norms and the presence of mandatory enforcement mechanisms directly determine the effectiveness of innovation and energy policies. It also reinforces the overall conclusion of the study: institutionally weak and less detailed Ukrainian regulations generate lower innovation outcomes compared to the comprehensive, imperative, and standardized EU system.

DISCUSSION

Comparisons between the EU and Ukraine are made in an obvious way in terms of analysis. Like the legal framework of the EU reveals several benefits of right regulation. European green deal and regulation (EU) 2021/2085 provide sound sustainability goals using relaxed standards. This process enables the innovation at the firm level within foreseeable limits. It gives a certain evidence in support of the Porter Hypothesis. These were supported by the evidence showing that environmental regulation encouraged efficiency gains across European sectors, by Rubashkina et al. (2015) and Holovnia et al. (2024), and by Ladi and Bertarelli (2023) and Haltsova et al. (2024) who established that the state of the eco-innovation in EU countries enhanced with a lower regulatory burden. These results are generalizers of these findings, in that they demonstrate that over 70 percent of the variation in EU innovation activity can be explained by legal enforceability and institutional coherence. Such a power of explanations was not emphasized in the literature before. This dual-method design represents a novel contribution by linking textual legal analysis to quantitative innovation metrics.

Ukraine's results partly align with prior studies but also reveal important divergences. Similar to Shpak et al. (2025) and Kozlovskyi et al. (2022), this analysis confirmed that bureaucratic inefficiencies and weak enforcement mechanisms remain key barriers, resulting in lower patent output and innovation scores. However, while Satrovic et al. (2024) and Heitor (2024) emphasized that regulatory incentives alone could promote sustainable innovation in transitional economies, this study's findings suggest that incentives in Ukraine are insufficient without institutional reforms, since subsidies and declaratory laws often fail to translate into measurable innovation. Similarly, Xinyu et al. (2025) and Kichuk and Shevchuk (2020) highlighted the potential of targeted green energy legislation in post-conflict recovery, which resonates with Ukraine's law no. 9381 on sustainable energy transformation (Verkhovna Rada of Ukraine, 2025); yet, the current study evidence shows that without strong enforcement and predictable procedures, these initiatives remain under-realized. Thus, this research not only confirms the positive role of regulation in the EU but also nuances the debate by showing that in fragile governance systems, regulatory intent does not automatically produce innovation outcomes.

For Ukraine, the theoretical implication is more complicated. While the correlation between legal frameworks and innovation outcomes exists, it is significantly weaker. This suggests that transitional economies require not only the presence of norms but also capacity-building to ensure their effective implementation. From a policy transfer perspective, Ukraine could benefit from adopting elements of the EU's approach to streamline investment processes and reduce bureaucratic hurdles. By institutionalizing similar mechanisms, Ukraine could overcome systemic inefficiencies while aligning its policies with EU accession goals and the SDGs (Ksonzhyk et al., 2021; Kuzior et al., 2025; Romaniuk et al., 2024).

The general importance of these results is two-fold. In theory, the study will be relevant to the body of literature on SD and innovation through validation of the Porter hypothesis in the setting of the EU. The environmental regulation designed in a proper way can be the impetus of technological advancement and not a hindrance. It goes further to provide this argument by showing the boundaries of regulation influence in the transitional economies where the enforcement power is weak. In practice, the results have a consequence on the integration of Ukraine into the EU. In case Ukraine wants to conform to EU standards and norms, it has to go beyond a declaration and begin implementing a more embedded, enforceable legal system that compensates sustainable innovation. This would improve the output in innovation, speed up the process of implementing SDGs, and increase the impact of Ukraine in the European green transitions.

There were significant limitations to this study especially in accessibility and dependability of Ukrainian data. The current Russian aggression in the war against Ukraine and the

economic turmoil since 2022 have constrained access to regular empirical data, especially on the output in the field of innovations and the annual level of R&D spending by the sector. Although international database triangulation, in comparison to the World Bank (2025) global innovation index and the EPO patent database has shown some strength, the lack of domestic uniformity data creates the possibility of bias in cross country comparisons. Further, it is possible that the informal practices or subnational differences within Ukraine are not reflected as well by the fact that the study relies on the help of doctrinal legal analysis. Future studies ought to expand this analysis, including firm-level case studies, survey of R&D managers or econometric models that would describe the firm-specific effects. Other transitional economies could also be part of the comparative work, and this would allow understanding EU-aligned reforms more broadly in terms of their impact on innovation in various political and institutional setups.

The following policy recommendations are given to Ukraine based on the findings.

1. *Short-term priorities*
    - Update outdated laws, such as the 2002 Law "On Innovative Activity", so that they are more flexible and explicitly aligned with the SDGs.
    - Complement subsidies with R&D tax credits, broadened grant programs, and transparent funding mechanisms to encourage sustained investment in green innovation.
2. *Long-term priorities*
    - Establish a centralized agency modeled on the EU's Sustainable Investment Facilitation Agencies (SIFAs) to act as a one-stop mechanism for innovators and investors, reducing delays and limiting corruption.
    - Deepen participation in initiatives such as Horizon Europe to link domestic innovators with global research networks and attract international investment.
    - Embed the SDGs into national legislation through measurable benchmarks to ensure reforms yield tangible outcomes, supporting EU accession and domestic sustainability goals.

CONCLUSION

The analysis indicates that the thorough, flexible and binding system of regulations in the EU allows it to have a high level of eco-innovation. This is evident in the fact that it scores higher in global innovation index, more investments in R&D and a very large figure of green patent registrations yearly. Regulations proposed by major projects like the EU green deal (2019) and regulation (EU) 2021/2085 not only establish high standards of sustainability but also give companies the freedom to be innovative. This is further supported by statistical analysis which confirms that the variation in the outcome of innovation is explained by EU legal norms over 70 percent.

Nonetheless, the legal framework in Ukraine remains still divided a blend of progressive changes and areas of weaknesses. Even though the recent changes in policy such as the law no. 9381 on sustainable energy and the national guiding framework on standards have indicated a change in the policy to be more sustainable and eco-industrial, the system continues to have structural issues that restrain its efficacy. These changes however mirror the increasing recognition of the necessity to match national strategies with the SDGs and the EU accession requirements (World Bank, Government of Ukraine, European Commission, and United Nations, 2025). Nevertheless, the persistence of the previous and poorly implemented laws, including the 2002 law "on innovative activity" is a vicious cycle that compromises the consistency and restricts the performance of the innovation system in Ukraine. These gaps are empirically demonstrated by the comparatively small size of green patent (~500 per year) and by lower levels of R&D spending (0.9 percent GDP in comparison with the 2.2 percent in the EU). Ukraine has potentials especially in post-conflict green reconstruction. However, this possibility is not yet achieved due to the lack of more powerful enforcement tools and more effective institutional design.

The paper demonstrates some opportunities of future research and policy experimentation. There should be longitudinal studies to determine the impact of continued reforms such as those that were initiated in the wake of the 2022 on the performance of innovations with time. This would assist in knowing whether the legal and institutional changes in Ukraine can bridge the gap between the Ukrainian practice and the EU standards or there will be systemic obstacles. Moreover, pilot policy projects, including the establishment of sustainable investment facilitation agencies on the pattern of EU practice, would offer some evidence-based suggestions as to the most effective reforms to overcome bureaucratic obstacles and provoke eco-innovation in a transitional economy. The comparative studies with other states in the East Europe or Central Asia can also be carried out. They will be useful in giving important points of reference when it comes to drawing a line whether Ukraine issues are localized or are within a wider trend in the region.

This paper has already indicated that the EU has already developed a self-reinforcing mechanism in which powerful legal norms, good institutions and strong performance in innovation are interplaying. Ukraine, on the other hand, is yet to adopt such a system. The recent advances in green reconstruction laws and the attempts to be close to the SDGs indicate a bright future, but it will require a lot of legal, institutional, and financial changes to achieve the dynamism in its innovativeness as observed in the EU. Further progress in these domains would benefit the process of Ukraine joining the EU as much as contribute to discussing how, in the environment characterized by the economic transition and recovery after a conflict, law and governance can be used to support SD.

Unlike previous works that focus mainly on qualitative assessments of the harmonization of Ukrainian legislation with EU law, this study offers a comprehensive and methodologically consistent combination of doctrinal analysis and empirical modeling. The novelty lies in three key aspects.

A systematic thematic coding of legal norms of the EU and Ukraine for 2015-2025 was carried out, which makes it possible to quantitatively assess the difference in the institutional structure and implementation mechanisms. For the first time, a panel database of innovation indicators was constructed and statistical relationships between the "strength of legal norms" and innovation outcomes in both jurisdictions were tested. A comparative assessment of the effectiveness of legal incentives was carried out based on regression models, which demonstrates the different strength of influence of legal, institutional and financial mechanisms in the EU and Ukraine. Thus, the study complements the existing literature with new empirical findings and provides a deeper understanding of how the design of legal norms shapes innovation trajectories in the context of European integration.

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