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Exploring the Role of Green Training on Organizational Resilience: A Multisectoral European Analysis

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ABSTRACT

The double transition paradigm has imposed to redefine the rules to compete. The demand for green skills, driven by European policy targets, currently outpaces the supply available in the labor market. This study surveys European companies across multiple sectors to assess the role of green training, a key element of green human resource management, in bridging this gap. Additionally, it evaluates the influence of green training on the internal work climate and the firms' green reputation and performance. The results indicate a positive impact of green training on the internal working climate and through it on the green reputation and performance of firms involved in the survey, encouraging its adoption in their strategies. The final goal is the definition of the role of green training both from an academic and practical point of view in addressing the challenges imposed by the increasingly turbulent environment building long-lasting resilience of companies.

1 | Introduction

The recent challenges imposed by digitalization, the green transition, and European demographic trends have profoundly impacted multiple dimensions of society, including the labor market (Cedefop 2024). In particular, the green economy paradigm has introduced the green job concept (Battaglia et al. 2018), which has been defined by ILO and UNEP as a work position that contributes substantially to preserving or restoring environmental quality (Castillo 2023).

Assessing the impact of the green transition on the labor market varies across countries and sectors, and several factors complicate this evaluation. These include the geographical distribution of workers (Vona et al. 2018; Dussaux 2020), the dependence of national GDPs on high-polluting industries, different definitions of green jobs, and the labor intensity of the sectors most affected by the transition (Causa et al. 2024).

Among these challenges, a key issue is the widespread misalignment between employers' requirements and the availability of employees with suitable profiles (LinkedIn 2023). Despite a 54.6% higher hiring rate for green-skilled or green-titled individuals, society is currently lacking 18.7% of the green talent required to meet the ambitious EU targets for 2030, an issue that is projected to worsen by 2050 (LinkedIn 2024). Demand for green skills has grown significantly (Nikoloski et al. 2024; Sulich and Sołoducho-Pelc 2022), driven by alignment with policymakers' goals and influenced by European-level initiatives such as Agenda 2030, the Sustainable Development Goals (SDGs), the European Green Deal, the Fit for 55 directive, the Net-Zero Industry Act, and the 2024 revision of the Waste Framework Directive (Koundouri et al. 2023).

Redefining workers' competences is essential for enhancing resilience within the labor market, reducing vulnerability to external shocks and market fluctuations (Borgonovi

et al. 2023). This is particularly urgent given the obsolescence of many current job profiles, outdated production processes, and the environmental impact of various supply chains (Vandeplas et al. 2022), as well as the sector-specific variability of these effects.

Despite the evident need for green skills to support the long-term transition and adaptation of traditional businesses, both public institutions (Cedefop 2024) and academic research (Xie et al. 2020) have highlighted a persistent misalignment between labor demand and supply. This gap can potentially be bridged through green training (GT), particularly considering the challenges employees face in rapidly acquiring the necessary knowledge and expertise to enhance organizational sustainability performance (Pinzone et al. 2019). In this context, the role of training, as clearly stated by the EU, seems to be a fundamental means to promote the adaptation of member states to new green skills requirements thanks to vocational education and training (VET) providers and country education systems (Cedefop 2010), also encouraging innovative approaches to learning like micro-credentials implementation (Council of EU 2022).

Given this context, the present study explores the impact of GT, aimed at the existing workforce within the European business landscape, on the green working climate (GWC), as well as the mediating role this dimension plays in fostering firms' green performance (GP) and green reputation (GR) in response to the demands of the green transition.

To investigate the role of green training in fostering voluntary green behavior (Amrutha and Geetha 2021) and improving environmental performance (Pham et al. 2020), we pose the first research question:

RQ1: To what extent does green training influence a firm's internal working climate and foster green behavior among the workforce?

The capacity to develop an internal culture rooted in skilled and engaged individuals who are fully committed to environmental objectives and aligned with the firm's strategic goals leads to enhanced environmental performance through the promotion of shared green behaviors (Sarfo et al. 2024). This consideration leads to the second research question:

RQ2: To what extent does the green working climate mediate the impact of green training on firms' environmental performance?

Practicing environmental sustainability, which can reshape workforce preparation and philosophy, not only reduces environmental impact but can also enhance a firm's reputation among various stakeholders and investors (Ervin et al. 2013) who prioritize similar values (Cable and Turban 2003; Brammer and Pavelin 2006). This consideration underpins the third research question:

RQ3: To what extent does the green working climate mediate the impact of green training on firms' green reputation?

The model used in this study is grounded in the Ability, Motivation, Opportunity (AMO) framework (Marin-Garcia and Tomas 2016), a key element of green human resource management (GHRM). We contribute to theory by focusing on the specific dimension of GHRM, GT, which plays a pivotal role in guiding the labor market toward environmentally sustainable and responsible production processes, enabling a quicker response to external changes (Viola and Marinelli 2014).

Despite the extensive body of research within management academia on GHRM and corporate sustainability (Shah 2019; Chaudhary 2020), Yong et al. (2020) emphasize the importance of exploring additional elements of this domain, such as GT, and their impact on organizational performance, including resilience-building over time.

Thus, this paper aims to expand the debate and enhance understanding of how GT supports long-term improvement in firms, whether directly or indirectly, by influencing organizational performance (Borah et al. 2023). It also seeks to offer practical insights for managerial leadership (Xie and Zhu 2020) and contribute to discussions on activities that effectively promote a sustainability-driven approach to resilience (Carmeli et al. 2020), across different countries and industries. The paper is structured as follows: First, we present the theoretical framework and the research model along with hypothesis development. This is followed by the methodology and statistical analysis sections, where key results are reported. The findings and discussion sections then elaborate on the main insights. Finally, we conclude with theoretical contributions, managerial implications, study limitations, and directions for future research.

2 | Literature Framework and Hypothesis Development

2.1 | Organizational Resilience and GHRM

Nothing more than climate change (Farooq et al. 2023) has stressed the importance for firms of being able to develop a strong capacity of adaptation to the increasingly frequent external shocks, mostly unpredictable. Regulatory frameworks, market pressures, the pursuit and preservation of competitive advantage, and the growing need to build long-term resilience (Doghan 2024) have made environmental sustainability compliance more urgent than ever. This slow but constant adaptation process can be encapsulated in the concept of organizational resilience, the ability of firms to cope with uncertainty by identifying the key antecedents that enable sustainable adaptation over time. Lengnick-Hall et al. (2011, 244) have defined organizational resilience as the "firms' ability to effectively absorb, develop situation-specific responses to, and ultimately engage in transformative activities to capitalize on disruptive surprises that potentially threaten organization survival."

One of the major issues of organizational resilience is its multidimensionality that makes it complex to separate single antecedents from cumulative constructs that are at the base of the organizations' existence (Ngoc Su et al. 2021). Nevertheless, many studies argue that human resource management (HRM) has a fundamental role in helping firms overcome crises

(Lengnick-Hall et al. 2011; Nilakant et al. 2014) and support business sustainability (Avey et al. 2008; Bustinza et al. 2019), hence in favoring resilience. Furthermore, GHRM has been examined through the lenses of the resource-based view (RBV) and stakeholder theory, particularly in the hospitality industry, by Elshaer et al. (2024). Their findings reveal correlations between GHRM and circular economy practices, green organizational culture, and both internal and external resilience, underlining GHRM's role in fostering long-term sustainability. Similarly, Adeola et al. (2021) observed that GHRM, particularly its components such as green recruitment and green training, enhances firm resilience over time (Gul et al. 2025).

The existing body of research strongly suggests that GHRM is directly linked to firm resilience, influencing the antecedents that enable organizations to withstand external shocks (Lu et al., 2023; Singh et al. 2020).

2.2 | Green Human Resource Management and Green Training

The concept of GHRM encompasses a variety of interpretations (Zhang et al. 2024). Drawing on the definition provided by Renwick et al. (2013), GHRM can be described as a holistic approach to workforce management that integrates environmental sustainability into human resource practices within business organizations. The incorporation of environmental components into HRM (Renwick et al. 2008) completes this conceptualization, leading to the definition of GHRM as a comprehensive framework.

GHRM is associated with programs, techniques, and processes implemented across workforce activities to reduce negative environmental impacts and enhance environmental performance (Arulrajah et al. 2015). This objective is primarily achieved through three key components of GHRM: selection and recruitment, training and development, and compensation and rewards (Zihan, et al. 2024). According to Jackson et al. (2011), employee training is a central pillar of GHRM, particularly in periods of transformation such as the green and digital transitions currently underway in Europe.

Several studies have confirmed the positive relationship between the components of GHRM and firms' economic performance (Carballo-Penela et al. 2023; Gharibeh 2019), as well as other dimensions of business performance (Marrucci et al. 2021; Huo et al. 2022).

Through the analytical lens of the Ability–Motivation–Opportunity (AMO) framework, this study investigates GT initiatives as strategic mechanisms of human resource development (Marin-Garcia and Tomas 2016). The AMO framework shares a foundational alignment with GHRM (Vázquez-Brust et al. 2023) and was originally developed by Bailey (1993). It identifies three essential components for fostering high employee involvement and performance within organizations. The first component, ability, refers to employees' possession of the knowledge and skills required to perform their roles effectively. This can be enhanced through specific recruitment and selection methods, development initiatives, and formal training programs (Raidén et al. 2006). In this context, GT is defined as "a type of training related to relevant environmental topics, which enables all staff to integrate firm's performance with environmental issues" (Teixeira et al. 2016, 170).

GT is also considered a process of continuous learning aimed at enhancing employees' capacity to acquire environmental sustainability knowledge and develop spontaneous green behavior over time (Liu et al. 2020). It becomes a crucial driver for sustainable organizational performance, helping companies to improve products and processes through the acquisition of new competencies by their workforce (Fernando et al. 2019), while aligning corporate objectives with individual career development (Xie et al. 2020) and promoting a higher retention rate (Palupiningtyas et al. 2025). Nevertheless, some scholars (e.g., Pinzone et al. 2019) have highlighted potential drawbacks of GT, including increased workload for employees (Oppenauer and van de Voorde 2018), heightened stress levels, and greater pressure within the work environment (Topcic, et al. 2016).

2.3 | Green Training and Green Working Climate

Proenvironmental behavior is fundamental to the advancement of sustainable development (Paillé and Boiral 2013). Accordingly, the study of the determinants of an internal climate conducive to achieving sustainability goals has been increasingly addressed by scholars in environmental psychology (Bamberg and Möser 2007; Clark et al. 2003).

The GWC refers to employees' perceptions of their organization's and coworkers' orientation toward sustainable behavior (Norton et al. 2014). Huo et al. (2022) examined the relationship between the green internal working climate conceptualized as comprising both green climate and green engagement, and GT, exploring GT's direct effects on employees. GT is considered effective in enhancing employees' environmental awareness, knowledge, and skills (Pham, Vo-Thanh et al. 2020).

This is particularly important, as GHRM, of which GT is a key component, is responsible for fostering environmentally responsible behavior in the workplace (Ren et al. 2018) and for promoting Organizational Citizenship Behavior for the Environment (OCBE) over time (Pinzone et al. 2016). Such behavior has been defined as "individual and discretionary social behaviours that are not explicitly recognized by the formal reward system and contribute to more effective environmental management by organizations" (Boiral 2009, 222; Pinzone et al. 2019), in other words, the spontaneous adoption of proenvironmental conduct by employees. The identification of GWC as one of the antecedents of employees' proenvironmental behavior, also referred to as eco-initiatives, has been explored by Gusmerotti et al. (2023), who highlighted GWC's role in stimulating environmentally friendly innovation within organizations. However, some literature points to a potential negative trade-off between GT and GWC (Pinzone et al. 2019), suggesting the need to investigate this relationship. In light of this, and considering the limited number of studies that provide counter arguments, our first hypothesis seeks to examine whether the implementation of green

training results in an increase in proenvironmental behavior among employees and its effective internalization over time.

Hypothesis 1. *Green training positively influences green working climate.*

2.4 | Green Working Climate and Green Performance

The relationship between GHRM practices and firms' GP has been widely investigated, particularly in South Asian literature (Ren et al. 2018). More recently, empirical evidence has further validated this relationship, with Sarfo et al. (2024) identifying a significant positive association between the adoption of GHRM practices and firms' environmental outcomes. One key mechanism underlying this relationship is the acquisition of specialized knowledge and competencies related to environmental sustainability, which can strengthen organizational competitiveness and responsiveness (Obaid 2015). This highlights the importance of implementing environmental training initiatives that are tailored to the specific operational and strategic needs of the firm, thereby supporting the creation of long-term business value (Perron and Côte 2006). For such strategies to be effective, they must be supported by an appropriate GHRM framework (Marrucci et al. 2023), including a training system capable of fostering a strong internal GWC and employee engagement around sustainability objectives (Cherian and Jacob 2012). The acquisition of an internal green behavior acts as an intangible asset capable of fostering firms' GP and technological innovation in a long-term perspective (Shoaib et al. 2025). Moreover, Riasat et al. (2025) have highlighted the mediating power of GWC and its role in providing organizational support and fostering organizational performance.

Accordingly, we formulate the following hypothesis:

Hypothesis 2. *Green working climate positively mediates the relationship between green training and firms' environmental performance.*

2.5 | Green Working Climate and Firms' Green Reputation

As firms face increasing pressure to comply with environmentally responsible policies introduced at the European level (Aragòn-Correa et al. 2020), growing attention is being paid to the extent to which their environmental efforts are recognized by both internal and external stakeholders (Delmas and Toffel 2004). Although managers may have limited control over external factors such as government regulations, which often fall outside their direct influence, there is strong evidence that organizational culture and strategic priorities can significantly shape a company's environmental reputation (Wang and Zhao 2023). The attractiveness of working for firms that embrace sustainability principles, along with the support these companies receive throughout sustainable supply chains, has been confirmed in recent studies (Merlin and Chen 2022; Marrucci et al. 2021; Daddi et al. 2021). An internal climate aligned with sustainability values, combined with active employee engagement in environmental goals, can contribute to a positive perception of the firm by external stakeholders.

Managers can play a key role in this process by fostering employee participation in the external communication of sustainability values through mechanisms such as green employer branding (Sulich 2021). The successful implementation of green strategies, therefore, depends not only on formal policies but also on the degree to which sustainability principles are internalized by employees, who may act as proactive agents in enhancing the firm's external GR.

Based on these considerations, we propose the following hypothesis:

Hypothesis 3. *Green working climate positively mediates the relationship between green training and firms' green reputation.*

3 | Methodology

3.1 | Study Context

This study focuses on four key private European sectors, agri-food, construction, manufacturing, wood and furniture, and the public sector to ensure heterogeneity and representativeness of the challenges associated with the green transition. The agri-food industry is characterized by a significant environmental impact, being one of the largest contributors to European greenhouse gas emissions, particularly related to preproduction and postproduction phases and accounting for 19% of emissions during transportation (Crippa et al. 2021; Li et al. 2022). Furthermore, this sector exemplifies the typical European business landscape, dominated by SMEs and a distinctive workforce profile that includes seasonal and weekend workers, as well as an aging labor force often resistant to change. Structural transformations related to resource use, such as sustainable food production, precision agriculture, organic farming, agri-ecology, agri-forestry, and enhanced animal welfare standards, are reshaping traditional farming practices, alongside new eco-schemes incentivizing environmental and climate performance (Marini et al. 2011).

The construction sector, responsible for approximately 40% of total energy consumption, is undergoing substantial change driven by the emergence of climate-resilient buildings, smart homes, and renovation initiatives for both private and public properties (Business Europe, 2021). In the manufacturing sector, the adoption of advanced production technologies, increased technological complexity, and greater automation and robotization via Industry 4.0 are creating demand for a workforce with broader interdisciplinary skills. Additionally, digitalization, the shortening of value chains, and the integration of new materials necessitate continuous adaptation in workers' competencies to meet evolving industry requirements (CEDEFOP 2023b).

The wood and furniture sector has experienced significant impacts due to forest protection policies. The 2013 European Commission staff working document "A Blueprint for the EU

Forest-Based Industries" highlighted an overall decline in forest-based industries, with over 9% of firms closing over 8 years, underscoring the need for sustainable growth through enhanced competitiveness (EC 2013). This challenge is being addressed through initiatives such as the Wood Furniture Scorecard, designed to guide wood sourcing policies in furniture companies (Sustainable Furnishing Council 2024). Emerging opportunities for forest-based industries are linked to strategies aligned with the European Green Deal, including the EU Bioeconomy and Circular Economy agendas.

Green transversal skills, such as those related to reuse, recycling, and waste management, are increasingly influencing Public Administration structures, requiring workforce adaptation, particularly in light of external shocks like the COVID-19 pandemic. The crisis revealed both strengths and vulnerabilities within the sector, emphasizing the importance of resilience building in accordance with the Sustainable Development Goals (Meuleman 2021).

3.2 | Sample

The data have been collected from a sample of European firms located in Bulgaria, Italy, the United Kingdom, Spain, and Finland, coming majorly from the strategic sectors presented in Section 3.1. The participants have been contacted thanks to the involvement in the Erasmus Project Mastery, by national consortium partners, following a nonconvenience (snowballing) sampling technique (Stratton 2021).

The heterogeneity of the sample can be justified by two important aspects. The first one is related to the desire to give a holistic representation of a multicultural geographical area like Europe, where the levels of readiness and adaptation regarding green transition drastically differ (Khalique et al. 2025) as reflected by the approach to GHRM (Claus 2003; Aral and López-Sintas 2023) and the adoption of well-established policies and infrastructures to support circularity (Laureti et al. 2024). The second is related to the different levels of dependencies of industries on traditionally polluting resources and specific industrial practices (Georgescu et al. 2025). For this reason, observing different sectors and countries could have been potentially useful to identify variations related to "pollution dependencies" and "cultural propensity" and consequently in the formulation of indications to local authorities and managers (Miah et al. 2024).

The sample counts 199 complete answers. The majority come from Italian respondents (105), followed by Bulgaria (37), Finland (23), the United Kingdom (20), and Spain (14). The most represented sectors are construction (38), manufacturing (35), agri-food (25), and public administrations (23). To achieve the maximum diffusion of the survey, the selection of the respondents has been performed through a nonprobability sampling methodology, convenience sampling (Galloway 2005), that has been useful considering the dimension of the population and the complexity to reach it (Etikan et al. 2016). The responses have been collected between May and August 2024.

With this approach, we obtained a multisectoral and multicountry representation of the European business tissue considering the different impacts caused by the green transition (Strietska-Ilina et al. 2021).

3.3 | Variables and Research Model

The research questions were broken down into specific hypotheses (see Sections 2.3–2.5) to test: (1) the direct effect of green training (GT) on green working climate (GWC) and (2) GT's mediating role in shaping green performance (GP) and green reputation (GR). The items used in the survey have been measured with a 5-point Likert scale (Sullivan and Artino 2013) ranging from 5 = *strongly agree* to 1 = *strongly disagree*. GWC acts both as a dependent variable, when the relation with GT is assessed, and as a mediating variable for the relation with GP and GR. To measure it, four different items were used, two related to green engagement and green tasks involvement, and two related to personal and organizational green awareness (Huo et al. 2022). Two items have been used to measure firms' green performance (Hadi et al. 2023), focusing on material use and waste management, both adaptable to different industries, whereas four items have been used to assess firms' green reputation with different types of stakeholders throughout the entire value chain (Marrucci et al. 2021; Daddi et al. 2021). To have a better representation of the variables used in our model, we have measured them through different items that are able to cover multiple aspects. Throughout the statistical analysis, we decided to aggregate them, because they give representation of the same item, to facilitate the statistics process, making it clear, and creating more manageable data in the software. The explanatory variable is the dichotomic variable GT that ranges between 1, if the organizations are already performing GT activities, and 0, if they are not doing them. To assess the presence of possible differences in GT effect, countries and industries have also been adopted as control variables. GWC acts both as a dependent variable, when the relation with GT is assessed, and as a mediating variable for the relation with GP and GR. To measure it, employees were asked to express their level of agreement with four different affirmations (Huo et al. 2022) that analyze their perception of the environmental goals of the organization and their level of involvement with eco-friendly tasks. The study has been performed through the application of regression analysis to measure the level and strength of the correlation between the application of GT programs inside the organizations and the results obtained in terms of the internal GWC and then its moderating effect on performance and reputation. All the analysis has been performed using STATA software. The final model on which we based the analysis is described in the graph below (Figure 1) and tests the influence of GT on GWC focusing on the personal dimension of the organizations, according to GHRM theory and then the mediating role of GWC, fostered by GT on the GP and GR of the organizations.

4 | Results

4.1 | Preliminary Analysis and Tests

The first passage has been the conversion of the variables used into numeric ones. This phase has been fundamental because it made possible to perform the statistical inferences. Numeric

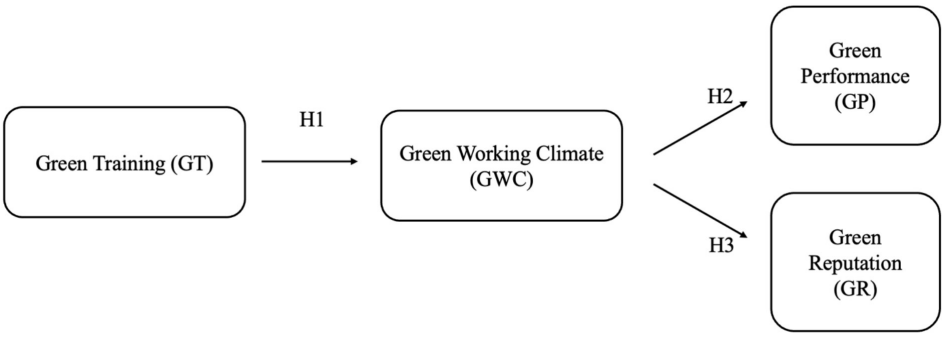

FIGURE 1 | Model representation of relations between the variables considered. *Source:* Elaboration by the authors.

TABLE 1 | Cronbach alpha analysis of the variables.

Variables (Y)	Cronbach's alpha	No. of items
Green working climate (GWC)	0.8204	4
Green firm performance (GP)	0.8702	2
Green firm reputation (GR)	0.9241	4

TABLE 2 | B-series correlation analysis.

Variables	GT	GWC	GP	GR
GT	1.0000			
GWC	0.1824	1.0000		
GP	0.1154	0.6030	1.0000	
GR	−0.0489	0.5005	0.4816	1.0000

TABLE 3 | Spearman correlation analysis on ordinal variables.

Variables	GWC	GP	GR
GWC	1.0000		
GP	0.6250	1.0000	
GR	0.4800	0.4566	1.0000

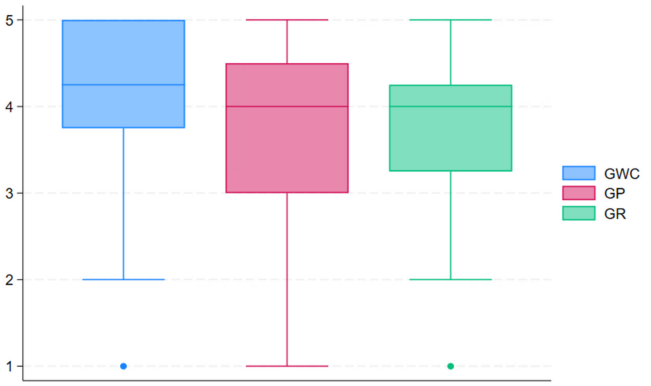

FIGURE 2 | Box plot representation of green working climate, green performance, and green reputation.

values have been attributed to the Likert scales from 1, *totally disagree*, to 5, *totally agree*, and to the dichotomous GT variable that is equal to 0 if the organization does not perform GT activity for its employees or 1 if it does. Cronbach's alpha coefficient test has been used to measure the reliability of the dimensions applied in the questionnaire, before performing the correlation and the regression analysis. The results have shown good reliability according to the Cronbach alpha value that is abundantly above 0.7, demonstrating that the items chosen are appropriate and reliable (Table 1).

After this, a b-series correlation analysis, because GT is dichotomic and assumes values that range between 0 and 1, has been performed to verify the presence of a linear correlation between the variables.

As clearly shown in Table 2, there is a strong correlation (above 0.6) between GWC and GP. There is also a strong correlation (above 0.5) between GWC and GR. The test also shows an acceptable correlation (close to 0.2) between GWC and GT (Table 2). This is extremely important because the present study wants to assess the impact of GT on GWC and the mediating role of GWC on GP and GR.

To confirm the robustness of the correlations and conduct additional tests, a Spearman correlation analysis was performed. Because the Spearman test applies only to ordinal variables, the dichotomous variable GT was excluded. The results of the Spearman test (Table 3) closely mirror those observed in the previous analysis, particularly regarding the correlations between GP and GWC, and between GR and GWC, which are critical for supporting our hypotheses.

Finally, box plot graphs were used to detect the presence of outliers and provide a graphical representation of the results obtained (Figure 2). Observing the figure, it is noticeable that GWC has a higher median value than the other two scales, whereas GP exhibits greater variability compared to the others. The variable GT was again excluded from the graph, as its values only range between 0 and 1.

4.2 | Hypotheses Test

The first regression analysis, with GT as the independent variable and GWC as the dependent variable, yields statistically significant results (Table 4). As shown in the tables, the *p* value is below the 0.05 threshold, indicating statistical significance. Although the model exhibits a relatively low R^2 value, the regression coefficient suggests that GWC increases by 0.25 when GT shifts from 0 to 1. Therefore, the first hypothesis is supported.

The following analysis examines the mediating role of GWC in the relationship between GT and GP, as well as between GT and GR. As clearly shown in the corresponding tables, the favorable *p* values in both cases indicate statistically significant relationships. Moreover, the relatively high R^2 values, 35% for GP (Table 5) and 25% for GR (Table 6), demonstrate a satisfactory level of model predictiveness. These results provide empirical support for both the second and third hypotheses of the model.

To assess potential differences in the regression analysis across countries and industries, both factors were included as control variables in the model. These controls have been included to account for systematic differences related to industry- and country-specific characteristics that may influence the relations analyzed independently of the other variables in the model. The results varied depending on the variables examined. In the case of the relationship between GT and GWC, the inclusion of control variables did not lead to substantially

TABLES 4 | regression between GT (independent variable) and GWC (dependent variable).

Source		SS		df	MS
Model		3.18154785		1	3.18154785
Residual		94.246216		197	0.478407188
Total		97.4277638		198	0.492059413
GWC	**Coefficient**	**Std. err.**	***t***	***P*>|*t*|**	**95% conf. interval**
GT	0.2536063	0.0983421	2.58	0.011	0.0596678, 0.4475447
_cons	4.088785	0.0668662	61.15	0.000	3.95692, 4.220551

Note: No. of obs = 199. $F(1, 197) = 6.65$. Prob > $F = 0.0106$. R squared = 0.0327. Adj R squared = 0.0277. Root MSE = 0.69167.

TABLE 5 | Regression analysis between GWC (independent variable) and GP (dependent variable).

Source		SS		df	MS
Model		55.8033464		1	55.8033464
Residual		102.341324		195	0.524827301
Total		158.14467		196	0.806860561
GP	**Coefficient**	**Std. err.**	***t***	***P*>|*t*|**	**95% conf interval**
GWC	0.7579598	0.0735062	10.31	0.000	0.6129905, 0.9029291
_cons	0.5905626	0.313508	1.88	0.061	−0.0277392, 1.208864

Note: No. of obs = 197. $F(1, 197) = 106.33$. Prob > $F = 0.0000$. R squared = 0.3529. Adj R squared = 0.3495. Root MSE = 0.72445.

TABLE 6 | Regression analysis between GWC (independent variable) and GR (dependent variable).

Source		SS		df	MS
Model		27.817602		1	27.817602
Residual		83.1901299		192	0.433281927
Total		111.007732		193	0.575169596
GR	**Coefficient**	**Std. err.**	***t***	***P*>|*t*|**	**95% conf interval**
GWC	0.5423325	0.0676848	8.01	0.000	0.4088312, 0.6758337
_cons	1.525813	0.2891929	5.28	0.000	0.9554094, 2.096216

Note: No. of obs = 194. $F(1, 197) = 64.20$. Prob > $F = 0.0000$. R squared = 0.2506. Adj R squared = 0.2467. Root MSE = 0.65824.

TABLE 7 | Regression between GWC (dependent variable) and GT (independent variable) with country and industry as control variables.

Source	SS	df	MS
Model	7.96461538	10	0.796461538
Residual	89.4631484	188	0.475867811
Total	97.4277638	198	0.492059413

GWC	Coefficient	Std. err.	*t*	*P*>|*t*|	95% conf interval
_IIndustry_2	−0.2172339	0.2550357	−0.85	0.395	[−0.7203333, 0.2858655]
_IIndustry_3	−0.038006	0.2173376	−0.17	0.861	[−0.4667398, 0.3907277]
_ IIndustry_4	0.0301263	0.2085823	0.14	0.885	[−0.3813363, 0.4415889]
_IIndustry_5	−0.2219449	0.2379097	−0.93	0.352	[−0.6912605, 0.2473708]
_IIndustry_6	0.1788139	0.3521575	0.51	0.612	[−0.5158741, 0.873502]
_ICountry_2	−0.3103591	0.2525327	−1.23	0.221	[−0.8085209, 0.1878027]
_ICountry_3	−0.4936991	0.2625081	−1.88	0.062	[−1.011539, 0.0241409]
_ICountry_4	−0.1599027	0.1986152	−0.81	0.422	[−0.5517035, 0.2318981]
_ICountry_5	−0.1374815	0.3308978	−0.42	0.678	[−0.7902312, 0.5152682]

Note: No. of obs = 199. $F(10, 188) = 1.67$. Prob > $F = 0.0895$. R squared = 0.0817. Adj R squared = 0.0329. Root MSE = 0.68983. _IIndustry_1 for agrifood, omitted. _ICountry_1 for Bulgaria, omitted.

TABLE 8 | Regression analysis between GP (dependent variable) and GWC (independent variable) with country and industry as control variables.

Source	SS	df	MS
Model	68.8224052	10	6.88224052
Residual	89.3222648	186	0.48022723
Total	158.14467	196	0.806060561

GP	Coefficient	Std. err.	*t*	*P*>|*t*|	95% conf interval
_IIndustry_2	0.3831248	0.2704308	1.42	0.158	[−0.1503812, 0.9166307]
_IIndustry_3	0.1398864	0.2214096	0.63	0.528	[−0.2969104, 0.5766832]
_IIndustry_4	0.1208054	0.2130697	0.57	0.571	[−0.2995384, 0.5411493]
_IIndustry_5	−0.4411842	0.2422169	−1.82	0.070	[−0.9190297, 0.0366613]
_IIndustry_6	0.2588244	0.3564496	0.73	0.469	[−0.4443795, 0.9620283]
_ICountry_2	−0.1320968	0.2513248	0.53	0.600	[−0.3637168, 0.6279105]
_ICountry_3	−0.2251936	0.2792265	−0.81	0.421	[−0.7760516, 0.3256644]
_ICountry_4	−0.0609047	0.2002638	−0.30	0.761	[−0.4559851, 0.3341758]
_ICountry_5	0.1372806	0.3311823	0.41	0.679	[−0.5160758, 0.790637]
GWC	0.7158407	0.072133	9.92	0.000	[0.5735367, 0.8581446]
_cons	0.703484	0.4128029	1.70	0.090	[−0.1108936, 1.517862]

Note: No. of obs = 197. $F(10, 183) = 14.33$. Prob > $F = 0.0000$. R squared = 0.4352. Adj R squared = 0.4048. Root MSE = 0.69298. _IIndustry_1 for agrifood, omitted. _ICountry_1 for Bulgaria, omitted.

different outcomes; however, it did reduce the statistical significance of the results, with the p value exceeding the 0.05 threshold (Table 7). Therefore, it can be argued that there are no significant differences attributable to country or industry effects in this context.

In the regression analysis with GP as the dependent variable, a comparison between the models with and without control variables reveals that GWC remains highly significant in both cases ($p < 0.001$). Moreover, the coefficient for GWC remains relatively stable, with values of 0.75 in the simple regression and 0.71 in

TABLE 9 | Regression analysis between GR (dependent variable) and GWC (independent variable) with country and industry as control variables.

Source	SSfv	df	MS
Model	39.8055665	10	3.98055665
Residual	71.2021655	183	0.389082871
Total	111.007732	193	0.575169596

GR	Coefficient	Std. err.	*t*	*P*>|*t*|	95% conf interval
_IIndustry_2	0.040163	0.2359438	0.17	0.865	[−0.425357, 0.5056829]
_IIndustry_3	0.0365237	0.2028875	0.18	0.857	[−0.3637757, 0.4368232]
_ IIndustry_4	0.0932065	0.1980426	0.47	0.638	[−0.2975338, 0.4839468]
_IIndustry_5	−0.1226373	0.2282502	−0.54	0.592	[−0.5729778, 0.3277031]
_IIndustry_6	−0.229552	0.3233941	−0.71	0.479	[−0.8676124, 0.4085084]
_ICountry_2	−0.4313214	0.2259326	−1.91	0.058	[−0.8770891, 0.0144462]
_ICountry_3	−0.4784959	0.2476661	−1.93	0.055	[−0.9671441, 0.0101522]
_ICountry_4	−0.6061372	0.1771168	−3.42	0.001	[−0.9555908, −0.2566836]
_ICountry_5	0.0057716	0.2968899	0.02	0.985	[−0.5799957, −0.5915388]
GWC	0.5404205	0.0656058	8.24	0.000	[0.4109796, 0.6698615]
_cons	1.937432	0.3723261	5.20	0.000	[1.202829, 2.67206]

Note: No. of obs = 194. $F(10, 183) = 10.23$. Prob > $F = 0.0000$. R squared = 0.3586. Adj R squared = 0.3235. Root MSE = 0.62377. _IIndustry_1 for agrifood, omitted. _ICountry_1 for Bulgaria, omitted.

the model including control variables. Although the control variables themselves are statistically significant, their inclusion does not significantly alter the effect of GWC on GP. Therefore, the influence of GWC on GP appears to be robust across different industries and countries (Table 8).

In the model with GR as the dependent variable, however, country emerges as a significant factor, suggesting that it has an independent effect on GR, regardless of industry and GWC (Table 9).

With regard to these final results, the regression analysis incorporating control variables reveals a notably high, negative, and statistically significant coefficient for Country 4 (Italy). This indicates that, compared to Country 1 (Bulgaria), Italy is associated with a lower average level of GR, holding GWC and industry constant. However, variations in response rates across countries, particularly the overrepresentation of Italy, may affect the comparability and generalizability of these findings.

Concerning the mediating role of GWC, the inclusion of country and industry as control variables yields significantly higher explanatory power for both GP (Table 8) and GR (Table 9). These results suggest that the mediating effect of GWC varies meaningfully across countries and industries, highlighting contextual differences that influence the strength of this relationship.

5 | Discussion

Based on the statistical analysis results presented above, several key considerations can be drawn. First, Hypothesis 1, which tests whether green training (GT) positively influences the green working climate (GWC), is confirmed. This finding is particularly relevant given that, despite numerous studies attributing a generally positive effect of GT on employee behavior, some research has highlighted potential negative impacts related to increased workload and associated stress caused by additional learning demands (Pinzone et al. 2016; Oppenauer and van de Voorde 2018; Topcic, et al. 2016). Consistent with these findings, this study demonstrates that GT has a positive impact on the green working climate within the sample of European firms surveyed. This supports the European Union's emphasis on lifelong learning as a crucial mechanism to address green transition challenges and ensure sectoral resilience and adaptability to evolving market demands (Council of EU 2022). Hypotheses 2 and 3, which examine the mediating role of GWC in transmitting the positive effects of GT, primarily at the individual behavioral level, onto organizational outcomes such as green performance (GP) and green reputation (GR), are both supported. The very high R^2 values confirm the robustness and explanatory power of the models employed.

The mediating role of GWC with respect to both GP and GR emerges as highly significant, with strong statistical support and reliable results. These findings underscore the critical importance of considering GWC as a mediating variable for several reasons. First, this study evaluates the direct effect of GT on the "personal" dimension of the organization, namely, the workforce, and subsequently examines how the internalization of green behaviors by employees translates into tangible organizational outcomes, including environmental performance and external stakeholders' perceptions. This both confirms and extends previous literature (Pham et al. 2020; Huo et al. 2022).

Effective sustainability-oriented initiatives such as GT foster a positive internal climate, thereby mitigating risks associated with greenwashing or superficial adoption of environmentally friendly practices (Boiral 2007). This improved internal climate translates into enhanced environmental performance, as reflected in the strong relationship between GWC and GP, as well as into an improved external reputation, indicated by the link between GWC and GR.

The contrast between the personal behavioral effects of GT, conceptualized through the AMO framework introduced earlier, and the organizational outcomes underscores the necessity of incorporating GWC as a mediating factor in the analysis. Moreover, the study's inclusion of multiple European countries and sectors allows for a broad comparative perspective. The addition of control variables reveals that GT exerts a positive influence on internal organizational climate regardless of geographical or sectoral context, although country and industry exert more pronounced effects on green performance and reputation.

These findings highlight GT not only as a key institutional priority (CEDEFOP 2023a; Business Europe 2021) but also as a strategic lever within lifelong learning frameworks to support workforce adaptation to green transition demands. Tailored training programs addressing skills gaps identified at the European level equip employees with the necessary abilities, knowledge, and competencies (Fernando et al. 2019), fostering personal development (Xie et al. 2020) and proactive behaviors (Gusmerotti et al. 2023). This dynamic contributes not only to alignment with environmental trends but also promotes eco-innovation, culminating in what can be termed a "new green empowerment" that forms the foundation for improving firm-level green performance and reputation.

The results help address an academic gap identified by Yong et al. (2020), who call for deeper investigation of specific GHRM variables, such as green training, and their roles in building long-term organizational resilience across different industries and countries, providing actionable insights. Moreover, the present study contributes to the theory by indicating how green training, a fundamental part of the GHRM, represents a key lever to strengthen organizations' staff involvement and awareness of green issues, promoting proactive behavior and the consequent spontaneous change, opposite to the forced one, that allows firms to align with the indications of the European Union policymakers, improving their performance and reputation and consequently developing greater resilience in the long term.

Further research could expand on this work by exploring additional GHRM components and evaluating their strategic impact on firm structures. From a practical perspective, this study offers both managerial and policy implications. It advocates for the integration of continuous GT within corporate strategies as a critical factor for fostering organizational resilience and encourages firms to monitor evolving market trends proactively. Furthermore, it supports policy initiatives at European and national levels aimed at financing and promoting GT activities, thus facilitating firms' transitions toward sustainable business models.

6 | Conclusions

The double transition paradigm, combined with the European demographic trends, has imposed the necessity to redefine the vocation and education training (VET) systems at a global and European level, decoupling economic growth from resource exploitation. In this context, it is fundamental to establish the role of GT, according to the concept of long-life learning and constant improvement and its impact on the adoption of substantially environmentally friendly and proactive behavior from the workforce. At the same time, the study aims to investigate the mediating role of green working climate in fostering green performance and the reputation of the firm conveying the effect of the learning activity from the personal to a business dimension and justifying organization efforts toward GT.

There are some limitations that have to be correctly highlighted even if they do not invalidate the relevance of the study.

First, to reach a high representation and a consistent dimension, needed for the inferential purpose of the results, the sample has been selected according to convenience methodology. This means that the total number of answers cannot be proportionally attributed to each of the countries involved.

Second, the use of a dichotomous variable to represent GT is justified by two major aspects. The first one is that there are different training modalities and approaches, according to organizations' philosophy and country green skills awareness and readiness. Distinguishing between the different training modalities could have reduced the clarity of the study, especially during the gathering process of the data. In second place, the focus of our paper is to measure the effectiveness of GT in supporting the long-term resilience of organizations, according to the green transition. We wanted to distinguish between firms that have acknowledged the transition and started involving the workforce through training activities tailored to the needs identified and firms that are not completely aware of the needs associated with the transition and of the role of GT in promoting long-term resilience. For this second category, the outcome of our paper is particularly important because it shows how green training can promote the personal development of the workforce and better environmental performance and reputation of the whole organization.

Third, even if the relation between GWC and GT is statistically significant, the low value of R^2 shows a low predictability of the results. This is actually not surprising because GT, according to literature, influences only a component of the AMO framework ability whereas the others have not been taken into account in the present study. Basically, a complex construct like green working climate, which is related to the internalization of green values by the workforce (Uslu et al. 2023) turning them into proactive behavior (Gusmerotti et al. 2023), is influenced by numerous components that include external pressures (Duan et al. 2020) to comply with green policies, social expectations and competitive environment, and internal drivers related to enterprises' specific factors (Flagstad et al. 2022) other than incentives and training (Arhavbarien et al. 2024). What has to be highlighted is instead the statistical relevance and the positive influence that GT has on the internal climate of the organization, which is

undoubtedly clear and indicates the fundamental role acquired by this component to foster green transition in the labor market. The present research does not want to be completely exhaustive but aims to raise attention on the role of training and its impact on green working climate as an important leverage of firm capacity to adapt to the challenges imposed by climatic pressure and policymakers' requests, maintaining and possibly gaining competitive advantage over time.

Finally, the decision to not extend the evaluation to the direct relation of GT on GP and GR to complete the mediation analysis is made. This decision is due to the fact that we aim to test the psychological mediation role (Riasat et al. 2025) of the human component on two organizational variables like GP and GR. The shift between the social and organizational dimensions has been the focus of the analysis and this brought us to the decision of exploring the mediating effect, passing through the human component. The present study implies the necessity both for managers and policymakers to give more importance to green training inside firms' strategy and local recommendations. Organizations should dedicate more effort to the continuous improvement of the workforce, pledging time to a constant updating process according to the requirements set by EU policy instead of concentrating all efforts on a sudden change led by isomorphic push or by the immediate necessity to comply with new standards. This approach based on capitalization of results and scalability would lead to a better acceptance of change, one of the biggest obstacles identified, and a softer transition process that does not compromise organizational efficiency and workforce commitment. At the same time EU policies, should sustain organizations in a stronger way, building awareness regarding the role of continuous training for green transition, avoiding a forced and top-down approach that otherwise would be detrimental in terms of resilience building process.

Possible future research paths could be related to the exploration of the role of GT focusing on further specific dimensions and distinctions (e.g., different training modalities) or performing longitudinal case studies focusing on a specific country or a specific industry or even making comparisons related to the moderating role of green working climate between two specific countries other than the European context.

Author Contributions

Giulia Alessandri: conceptualization, methodology, formal analysis, investigation, data curation, writing (original draft), writing (review and editing), visualization. **Fabio Iannone:** conceptualization, investigation, writing (review and editing), visualization, supervision, funding acquisition. **Annamaria Pesci:** formal analysis, investigation. **Tiberio Daddi:** supervision, project administration, funding acquisition. **Fabio Iraldo:** supervision.

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