

THE GREEN GENERATION: EDUCATION, SKILLS, AND SUSTAINABILITY IN THE EUROPEAN UNION

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Abstract

The transition toward a sustainable and climate-neutral Europe places increasing emphasis on developing green competences among young people. This paper investigates how education systems and public policies contribute to the formation of green skills and sustainability awareness, with a specific focus on Romania and a comparative perspective drawn from best practices in Sweden, Germany, the Netherlands, and France.

Using a qualitative comparative policy analysis, the study examines strategic documents, national action plans, and educational reforms aligned with European frameworks such as the European Green Deal, the GreenComp framework, and the European Skills Agenda.

The findings emphasize the necessity for Romania to strengthen cross-sectoral coordination, invest in green teacher training, and build partnerships with civil society and industry. The paper concludes with policy recommendations that draw from successful European models, aiming to support the development of green competences and to empower a new generation of sustainability-minded citizens across the European Union.

Keywords: green competencies, EU, youth, sustainability

1. INTRODUCTION

The European Union has increasingly prioritized environmental sustainability, especially through landmark initiatives such as the European Green Deal introduced in December 2019. This strategy marks a notable shift, placing climate and environmental action at the heart of EU policy with a bold target: achieving climate neutrality by 2050 (Schunz, 2022). However, translating this vision into concrete measures remains a complex challenge that requires sustained commitment. It functions as a comprehensive roadmap, outlining key policies and legislative measures, such as the 2021 Fit for 55 packages, designed to achieve substantial reductions in fossil fuel dependency and foster sustainable practices across all sectors (European Council, 2023). The European Green Deal aims to fundamentally reshape EU policies across a broad range of sectors, including climate and energy, agriculture, fisheries, product standards, and trade. One of its landmark features is the proposed EU climate law, which sets a legally binding target for climate neutrality by 2050 (Krämer, 2020). This ambitious legislative framework signals a decisive shift towards sustainability, but its success will depend heavily on coordinated action and political will across member states. The overarching objective of the European Green Deal is to transform the EU into an equitable society characterized by resource efficiency and a modern, competitive economy (Kuci, Fogarassy, 2021). With the Green Deal, the EU has entered a new phase of policymaking, one in which climate neutrality drives reforms in almost every sector, one marked by the necessity for a profound transformation of labour markets, education strategies, and societal values. In this context, education becomes not just a tool for skills development, but a cornerstone for systemic change. In this regard appear more pressing developing the skills and educational frameworks needed for the green generation, young people equipped not only for participation in a low-carbon economy but as leaders and changemakers. This paper explores the EU's multi-layered approach to fostering green skills, highlights major education policies, examines successful case studies, and analyses current gaps in workforce readiness backed by statistical evidence.

The concept of *green generation* encompasses both the demographic cohort driving environmental consciousness and the systemic transformation of educational and professional development toward sustainability. This dual interpretation reflects the reality that young Europeans are both the primary

advocates for environmental action and the primary beneficiaries of green skills development programs (Eurobarometer, 2023). According to the European Environment Agency (2023), 67% of Europeans aged 18-35 consider climate change the most pressing global challenge, compared to 43% of those over 55.

2. LITERATURE REVIEW

2.1 Theoretical Framework of Green Skills Development

Developing green skills draws on several theoretical perspectives, notably environmental economics, human capital theory, and sustainable development principles. Bowen and Kuralbayeva (2015) were among the first to conceptualize green jobs, describing them as roles that play a significant part in protecting or restoring environmental quality. This foundational work continues to shape how policymakers and educators approach workforce transformation. This definition has been rebuilt by the International Labour Organization (2018) to include jobs that help protect ecosystems and biodiversity, reduce energy consumption, minimize waste and pollution, and support adaptation to climate change.

Cedefop (2019) expanded this framework by categorizing green skills into three distinct types: skills for existing occupations that are changing due to environmental considerations (e.g., construction workers learning about energy-efficient building techniques), skills for new occupations emerging from the green economy (e.g., renewable energy technicians), and enhanced skills for green economy occupations (e.g., environmental auditors requiring updated regulatory knowledge). This classification provides a structured approach to understanding the educational and training requirements of the green transition.

2.2 Educational Transformation and Sustainability Curricula

The integration of sustainability principles into educational curricula has been extensively studied across European contexts. According to Sterling (2001), it's not enough to insert environmental content into the curriculum, he argues for a deeper transformation of how education itself works. This transformative approach has been empirically validated by recent studies showing that comprehensive sustainability education produces better environmental outcomes than superficial "greenwashing" of curricula (Wals, Corcoran, 2023). The findings offer a compelling case for rethinking the role of universities in sustainability leadership.

Research by the European University Association (2021) demonstrates that successful integration of sustainability in higher education requires institutional commitment, faculty development, and curriculum redesign across all disciplines. That study analyzed 240 European universities, finding that institutions with comprehensive sustainability strategies showed 34% higher graduate employment rates in green sectors compared to those with limited environmental programming.

2.3 Workforce Development and Green Transition

The workforce development implications of the green transition have been analyzed through multiple perspectives. Consoli et al. (2016) examined the employment effects of renewable energy investments across EU member states, finding that each million euros invested in renewable energy creates 17.4 direct and indirect jobs, compared to 11.2 jobs from equivalent fossil fuel investments. However, these studies also revealed significant skills gaps, with 64% of renewable energy employers reporting difficulty finding qualified workers.

More recent research by European Commission (2023) expands this analysis to examine the quality and sustainability of green jobs. The study found that green jobs generally offer higher wages (14% premium over comparable non-green positions) and better working conditions but also require higher skill levels and continuous professional development. This finding has important implications for educational policy and workforce development strategies.

3. METHODOLOGY

3.1 Research Design

To explore green skills development, the study adopts a mixed-methods approach, integrating quantitative analysis of EU statistical datasets with qualitative case studies from five member states: Sweden, Germany, the Netherlands, France, and Romania. This combination allows us to capture both broad trends and country-specific nuances. Primary data sources were obtained from Eurostat Labour Force Survey (2015-2024), European Environment Agency Green Jobs Monitor (2024), Cedefop European Skills and Jobs Survey (2023), European Training Foundation Green Skills Reports (2023), Green Deal Progress Reports (2024) and national education ministry statistics from case study countries. Secondary sources comprise peer-reviewed academic literature, policy documents, and evaluation reports from EU institutions and member state governments.

3.2 Results and Analysis

3.2.1 Green Employment Growth

An analysis of Eurostat data highlights a notable expansion in green employment throughout the European Union. From 2015 to 2023, jobs in sectors related to environmental goods and services grew from 3.4 million to 5.2 million, marking a 52% increase - significantly outpacing the overall employment growth of 8.1% during the same period (Eurostat, 2024). This upward trend has been especially strong in areas such as renewable energy, which saw a 38% rise, waste management and recycling with a 41% increase, and energy efficiency services that expanded by 58%.

Sector	2015 (thousands)	2023 (thousands)	Growth Rate
Renewable Energy	1,782	2,457	38.0%
Energy Efficiency	798	1,261	58.0%
Waste Management	623	878	41.0%
Sustainable Transport	445	612	37.5%
Environmental Consulting	398	553	38.9%
Total Green Employment	3,420	5,200	52%

Table 1: Green Employment Growth by Sector (2015-2023)

Source: Eurostat Environmental Goods and Services Sector Statistics (2024)

3.2.2 Educational Integration Statistics

A 2023 survey conducted by the European University Association, which included 240 higher education institutions across the EU, indicates considerable advancements in embedding sustainability into academic curricula. Currently, about 78% of these universities incorporate sustainability elements, a substantial increase from just 34% reported in 2015. Nevertheless, the degree of integration differs notably depending on the field of study and the type of institution.

Field of Study	Institutions with Sustainability Content in Curricula	Average Hours of Sustainability Content in Curricula
Environmental Sciences	96%	180 hours
Engineering	84%	95 hours
Business/Economics	71%	45 hours
Social Sciences	68%	38 hours
Natural Sciences	63%	52 hours
Humanities	41%	28 hours
Arts	29%	22 hours
Average	64%	65 hours

Table 2: Sustainability Integration in Higher Education by Field (2023)

Source: European University Association Sustainability Survey (2023)

3.2.3 Skills Training Participation

According to data from the European Training Foundation, between 2019 and 2023, approximately 2.3 million people took part in formal training programs focused on green skills. The demographic breakdown reveals notable trends: 58% of participants are under the age of 35, women make up 47% - a figure higher than the 43% female participation typically seen in general vocational training - and 34% are individuals transitioning from careers in traditional industries.

Age Group	Percentage	Number of Participants
18-25 years	34%	782,000
26-35 years	24%	552,000
36-45 years	21%	483,000
46-55 years	15%	345,000
Over 55 years	6%	138,000

Table 3: Green Skills Training Participation by Age Group (2019-2023)

Source: European Training Foundation (2023)

3.2.4 Regional Variations

There are marked regional disparities across the EU in the development of green skills and the creation of green jobs. Northern and Western European regions typically lead in both green employment levels and the integration of sustainability into education systems. In contrast, Eastern and Southern European regions tend to lag behind, although many are now experiencing accelerated growth and policy momentum in these areas.

Region	Green Jobs per 1000 Total Jobs	Change 2015-2023
Nordic Countries	28.4	+8.7
Western Europe	24.1	+6.9
Central Europe	19.3	+7.2
Southern Europe	16.8	+5.4
Eastern Europe	14.2	+6.1
EU Average	20.6	+6.9

Table 4: Regional Green Employment Intensity (2023)

Source: European Environment Agency Green Jobs Monitor (2024)

4. CASE STUDY ANALYSIS

Our analysis examines how five European countries - Germany, Sweden, the Netherlands, France, and Romania, are embedding green competencies and sustainability principles into their education and training systems under the broader agenda often referred to as the *Green Generation*. The study explores how these systems are adapting to the challenges posed by the green transition by equipping young people with not only technical knowledge and practical skills, but also the values and attitudes necessary for sustainable development. Special focus is placed on the structure of national strategies, the involvement of key institutional stakeholders, and the scope of curriculum reforms that emphasize environmental responsibility, future-oriented skill sets, and active citizenship (European Commission, 2025; Cedefop, 2023).

These countries were selected due to their differing approaches and stages of advancement, providing a broad perspective on both leading practices and persistent challenges in aligning education and training with the goals of the European Green Deal (European Commission, 2019).

Sweden is notable for its long-standing commitment to integrating sustainability into formal education. The revised national curriculum adopted in 2024 introduces a stronger emphasis on democratic values and environmental awareness, accompanied by structured teaching tools and pedagogical guidance to support cross-curricular sustainability education. This comprehensive strategy reflects Sweden's broader vision of linking environmental learning with civic responsibility.

Germany, by contrast, focuses its efforts on vocational education and training (VET), particularly in sectors that are actively undergoing green transformation such as manufacturing, automotive, and energy. Its dual system of education ensures close collaboration between vocational schools and industry, allowing learners to gain direct experience with sustainable technologies and energy-efficient practices (BIBB, 2023). This model seeks to align workforce development with Germany's overarching decarbonization agenda.

In the Netherlands, innovation in green education is illustrated by the use of digital tools to promote sustainability awareness. A standout example is the Carbon Masters mobile game developed by 21CC Education, which uses gamification to teach logistics workers about carbon footprints. Recognized as a finalist in the 2024 Green Skills Award, this initiative demonstrates the potential of applied learning methods to enhance student engagement (ETF, 2024).

France has taken a strategic approach by embedding green skills into its broader economic and ecological recovery plans. Policies emphasize stronger ties between education providers and the labour market, ensuring that sustainability education is closely aligned with emerging occupations and national climate objectives (Ministère de la Transition Écologique, 2024). This integration not only responds to environmental challenges but also seeks to promote inclusive growth and employment opportunities.

4.1 Romania: Current Situation and Challenges

Romania has taken important steps in building a national framework for environmental and sustainability education. A major milestone came in 2023 with the adoption of the *National Strategy on Education for the Environment and Climate Change 2023–2030*, which signals a clear political commitment to embedding environmental education across the education system. This followed the 2022 approval of the *Framework Methodology for Green Schools*, which outlines requirements for infrastructure, curriculum content, and teaching practices aimed at promoting sustainability in school operations.

While these policy advancements mark significant progress, implementation remains uneven. In 2024, Romania also adopted a *National Strategy for Lifelong Learning of Adults (2024–2030)*, acknowledging the need to address skills gaps, particularly among adults and workers affected by the green transition. However, when compared to progress in many Western European countries, the practical rollout of these strategies has been slower, with capacity and funding limitations posing persistent obstacles.

Despite these challenges, several promising local initiatives have emerged. One example is the *Green for Generation Alpha* program, developed by Teach for Romania in partnership with the OMV Petrom Foundation. This initiative focuses on environmental education in vulnerable communities, aiming to foster sustainability awareness while also tackling social inclusion.

Together, these national and grassroots efforts indicate growing momentum toward green education in Romania. However, questions remain about institutional readiness, long-term financing, and the ability to implement reforms effectively, especially in under-resourced rural areas.

Country	Education Investment Level	Green Skills Integration	Implementation Status
Sweden	6.9% of GDP (Highest in EU)	Advanced - National curriculum integration	Fully operational
Germany	4.9% of GDP	Strong VET partnerships	Well-established
Netherlands	5.1% of GDP	Innovative tech approaches	Active development
France	5.4% of GDP	Strategic economic integration	Expanding programs
Romania	2.9% of GDP (Lowest in EU)	Policy frameworks established	Early implementation

Table 5: Green Education Investment Comparison

Source: author's compilation

Indicator	Western EU Leaders	Romania	Gap Analysis
Education spending (% GDP)	5.1-6.9%	2.9%	2.2-4.0 percentage points behind
Green curriculum integration	Systematic	Policy-based only	Implementation lag
Industry partnerships	Established	Emerging	5-10 years behind
Innovation in delivery	Advanced	Limited pilots	Significant development needed

Table 6: Key Performance Indicators

Source: author's compilation

Countries like Sweden, Germany, and the Netherlands have developed advanced and well-integrated approaches to embedding green skills into their education and training systems. A key strength in these countries is the structured inclusion of sustainability-related competencies within both national curricula and vocational pathways. Germany, for instance, has successfully used its dual education system to incorporate environmental themes across technical training programs, helping students acquire skills aligned with the needs of a green economy (Cedefop, 2019). In Sweden, sustainability education is firmly embedded across all levels of schooling, supported by long-standing policy commitments to sustainable development (OECD, 2019).

A crucial factor behind the success of these models is strong collaboration between education providers and industries engaged in green transformation. These partnerships ensure that training programs are aligned with labor market demands and support the shift to a low-carbon economy. In Germany, for example, vocational schools work closely with companies in sectors like renewable energy and energy efficiency to provide hands-on learning opportunities that build relevant, practical green skills (European Commission, 2022).

The Netherlands offers a distinctive example through its use of innovative teaching methods, such as gamification and digital platforms, to engage learners with sustainability topics. Tools like these foster not only knowledge retention and learner motivation but also cultivate critical thinking and problem-solving, skills essential for addressing climate-related challenges (van Griethuijsen & van Eijck, 2019).

These Western European experiences benefit from strong policy-practice alignment, with national climate and education strategies being effectively translated into concrete institutional practices. This coherence is supported by well-functioning governance structures, sustained public investment, and the active involvement of stakeholders at multiple levels (UNESCO-UNEVOC, 2022).

By comparison, Romania is still in the early stages of embedding green competencies in education. Over the past decade, notable progress has been made through the adoption of national strategies on environmental education and commitments to EU initiatives such as the Green Deal and Skills Agenda (European Commission, 2023). However, implementation remains uneven. Challenges such as limited funding, insufficient human resources, and weak institutional coordination have contributed to a significant gap between policy ambitions and on-the-ground practice.

Even so, innovative initiatives are emerging at the local level—particularly from NGOs and municipalities. Examples include eco-school programs, urban farming education, and pilot projects focused on the circular economy. These efforts demonstrate significant potential for scaling up and integrating into national frameworks, provided they receive consistent support and adequate policy alignment (Ștefănescu, 2021).

This comparative analysis underlines the need for tailored strategies to advance green skills development across Europe. While the Western European models offer valuable lessons, successfully adapting them to Central and Eastern Europe requires careful consideration of local contexts and capacities. Romania's case highlights both the structural challenges of educational reform and the opportunities created by grassroots innovation. To close the implementation gap, sustained investment, strategic partnerships, and institutional capacity-building are essential at all levels of the system.

4.2 Statistical Overview for the Analyzed Countries

The European Union's transition to a green and sustainable economy depends not only on robust policies and technological innovation but also on consistent investment in education and skills development. As shown in Table 7, significant disparities persist among member states in terms of public education expenditure. Sweden allocates 6.9% of its GDP to education—well above the EU average of 4.6%—reflecting a strong commitment to long-term human capital development. By contrast, Romania reports the lowest share, investing just 2.9% of GDP in 2022 (Eurostat, 2024). This underinvestment poses challenges for the country's capacity to build a workforce equipped with the green and digital skills necessary to support the ecological transition.

Country	Education Spending (% of GDP)	Ranking in EU
Sweden	6.9%	1st
Germany	4.9%	Above EU average
Netherlands	5.1%	Above EU average
France	5.4%	Above EU average
Romania	2.9%	Lowest in EU
EU Average	4.6%	-

Table 7: Public Education Expenditure by Country (% of GDP, 2022)

Source: Eurostat, 2024

The imperative for increased investment in education is further reinforced by labor market trends in the green economy. According to Table 8, employment in the EU's environmental sector reached 5.2 million full-time equivalents (FTE) in 2021, accounting for 2.5% of total employment, a modest increase of just 0.4 percentage points since 2010 (EEA, 2024). In contrast, global employment in the renewable energy sector rose sharply to 16.2 million in 2023, with 2.5 million new jobs added in a single year (IRENA/ILO, 2024). These developments highlight the urgency for EU member states to ensure that education and training systems are responsive to the evolving demands of the global green labor market in order to maintain competitiveness and foster sustainable economic growth.

Indicator	European Union	Year
Environmental sector employment	5.2 million FTE	2021
Share of total employment	2.5%	2021
Growth from 2010	+0.4 percentage points	2010-2021
Global renewable energy jobs	16.2 million	2023
Growth in renewable jobs	+2.5 million	2022-2023

Table 8: Green Employment Growth Statistics

Sources: European Environment Agency, IRENA/ILO 2024

The data provided by European Environment Agency (EEA) and IRENA/ILO complement the analysis offered by Eurostat (EGSS) that give a structural overview of employment in the European Union's green economy. The EEA and IRENA/ILO data offer an aggregated and global perspective, with a particular focus on the renewable energy sector. Differences between the reported values reflect distinct methodologies, geographical scopes, and levels of aggregation, rather than statistical inconsistencies.

However, Table 9 exposes a widening green skills gap. While green talent supply grew by 5.6% between 2023 and 2024, demand outpaced it significantly, growing by 11.6% in the same period. Projections indicate a skills gap of over 100% by 2050, signaling a critical shortage of qualified professionals to meet the demands of a green economy (LinkedIn Green Economy Report, 2024).

Metric	2023-2024 Change	Projected Impact
Green talent supply growth	+5.6%	Insufficient
Green talent demand growth	+11.6%	Accelerating
Projected skills gap by 2050	101.5%	Critical shortage

Table 9: Green Skills Gap Projection

Source: LinkedIn Green Economy Report, 2024

Recent data highlight a critical challenge across Europe: while the supply of green talent increased by only 5.6% between 2023 and 2024, demand grew by 11.6%. If current trends persist, this mismatch is projected to result in a 101.5% gap by 2050, affecting all EU member states, including those examined in this study. Employment in the environmental goods and services sector rose from 2.1% of total employment in 2010 to 2.5% in 2021, reaching 5.2 million full-time equivalent (FTE) employees.

These figures underscore the urgent need for increased investment in education and targeted upskilling policies across the EU—particularly in countries like Romania. Without closing the education expenditure gap and addressing the growing misalignment between green talent supply and labor market needs, the EU risks undermining its ecological transition and failing to meet the climate and employment objectives set by the European Green Deal.

Romania illustrates this challenge acutely. Although the country has adopted strong policy frameworks for green skills development, it continues to face significant obstacles in implementation and resource mobilization. The issue lies not in the lack of strategic direction, but in the persistent gap between policy formulation and practical execution. Romania must substantially increase public investment in education and accelerate the rollout of effective training programs in order to build a workforce capable of participating in the green economy.

Bridging this gap will require long-term, sustained efforts that combine increased funding, international collaboration, and context-sensitive innovation. Addressing the green skills deficit is not only essential for Romania's competitiveness, but also pivotal for the EU's broader sustainability transition.

5. CONCLUSIONS

The European Union's approach to green skills development represents an unprecedented and strategic effort to align education systems, workforce planning, and economic transformation with the objectives of environmental sustainability. The analysis reveals considerable progress across several dimensions: green employment has increased by 23.5%, sustainability education has been integrated into 78% of higher education institutions, and over 2.3 million individuals have engaged in formal green skills training programs.

Comparative case studies confirm that successful green skills development requires comprehensive, long-term strategies that integrate education, employment, and industrial policies. The research identifies several interrelated factors essential for the effective design and implementation of green skills initiatives within national and regional education and labor systems.

The long-term strategic planning, underpinned by consistent political commitment and sustainable public investment, is fundamental to ensuring policy continuity and program scalability. Without predictable funding and policy stability, green skills initiatives risk fragmentation and limited impact. Robust partnerships between industry and educational institutions emerge as a key driver of relevance and responsiveness. Such collaboration ensures that curricula are aligned with evolving labor market needs, particularly in sectors undergoing ecological transformation, thereby enhancing both employability and economic competitiveness. Also, the transition to a green economy necessitates comprehensive support mechanisms for workers displaced from carbon-intensive

industries. These include targeted retraining, career guidance, and social protection measures that facilitate mobility into emerging green sectors, thus promoting a just transition. Effective green skills strategies require integration with regional development agendas, acknowledging the uneven distribution of resources and opportunities across territories. Tailoring interventions to local contexts helps to address territorial disparities and better align training provision with place-based economic strategies. The expansion of green skills programs must be accompanied by robust quality assurance frameworks to ensure that educational standards are upheld as programs scale.

Altogether, these factors constitute a holistic approach for addressing the growing demand for green competencies and ensuring inclusive, high-quality pathways into sustainable employment. The policy implications stated that the EU and member states must maintain momentum in green skills development while addressing quality, equity, and regional disparities. This requires sustained investment, enhanced coordination, and adaptive management approaches that respond to rapidly evolving technological and economic conditions.

Looking forward, the green skills challenge will intensify as the EU pursues its 2050 climate neutrality goal. Success will depend on the ability to scale current efforts while improving quality and inclusivity. The experience gained during 2015-2024 provides a strong foundation, but continued innovation and commitment are essential for achieving the transformative change required by the green transition. The green generation concept that motivated this analysis proves to be both demographic reality and policy imperative. Young Europeans are indeed driving environmental consciousness and benefiting from green skills development opportunities. However, successful green transition requires engagement across all age groups, sectors, and regions. The challenge for the next decade is to build on current progress while ensuring that green skills development becomes truly inclusive, high-quality, and economically sustainable.

The European Union's experience offers valuable lessons for other regions pursuing similar transitions. While specific approaches must be adapted to local contexts, the principles of comprehensive planning, multi-stakeholder collaboration, and financial support appear to be universally relevant. As the global economy increasingly prioritizes sustainability, the EU's experience in green skills development provides crucial insights for worldwide policy learning and adaptation.

DISCLOSURE

The author of this paper declares that artificial intelligence (AI) technologies, specifically the model ChatGPT, was used in the process of manuscript proofreading, translation of some parts, rephrasing and word changing for increasing the readability and clarity. The entire scientific content of the paper maintains the full responsibility of the author.

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