FUTURITY OF SOCIAL SCIENCE

DOI: https://doi.org/10.57125/FS.2026.06.20.03

How to cite: Grigorescu, A., & Lungu, D.-C. (2026). Green jobs in Europe: Contemporary developments and future outlook. *Futurity of Social Sciences, 4*(2), 42–61. https://doi.org/10.57125/FS.2026.06.20.03

Green Jobs in Europe: Contemporary Developments and Future Outlook

Adriana Grigorescu*

[1]*National University of Political Studies and Public Administration, 30A Expoziției Boulevard, Bucharest 012244, Romania; Academy of Romanian Scientists, Ilfov Street 3, 050094 Bucharest, Romania, https://orcid.org/0000-0003-4212-6974*

Diana-Cristina Lungu

[1]*National University of Political Studies and Public Administration, 30A Expoziției Boulevard, Bucharest 012244, Romania, https://orcid.org/0009-0004-2880-5123*

Correspondence Email: *adriana.grigorescu@snspa.ro.*

Received: January 17, 2026 | **Accepted:** April 14, 2026 | **Published:** May 8, 2026

Abstract: The rise of green jobs has become a pivotal component of Europe's transition to a sustainable, low-carbon economy. As the demand for environmentally sustainable practices grows, green employment represents a significant opportunity for economic growth, job creation, and

social equity. This paper explores the role of green jobs in the European labour market, focusing on contemporary developments and future trends. It examines the European-level policies and strategies that promote the growth of green employment, including government frameworks, private-sector involvement, and the role of green human resource management. The article also assesses the emerging sectors driving the demand for green jobs and the growing need for green skills across industries.

Additionally, the paper addresses the challenges and research gaps in green job policies, including their impacts on social inclusivity, regional disparities, and long-term economic effects. As green jobs become increasingly central to Europe's sustainability goals, understanding these dynamics is critical for shaping effective policies and strategies. The article concludes by emphasising the need for continued research at the intersection of green employment, sustainability, and labour market policies to ensure long-term socio-economic development and prepare the workforce for future challenges.

Keywords: European labour market; Green jobs; green human resource management; labour market development; policy; sustainability

Introduction

With the growing importance of climate change, Europe is aligning itself with the green transition towards sustainability. This transition, underlined by commitments such as the European Green Deal, has redefined the labour market, prioritising environmental sustainability alongside economic growth and social equity. Green jobs, defined as roles that help preserve or restore environmental quality, have emerged as part of this transformation, embodying the link between economic opportunity and sustainable development.

The European labour market is undergoing a profound transformation, driven by ambitious environmental objectives and socio-economic needs. To achieve climate neutrality by 2050, as articulated in EU strategies such as the *European Green Deal* (European Commission, 2019) and *Fit for 55* (European Commission, 2021), green jobs are key to Europe's transition towards sustainability. These occupations encompass a wide range of activities – renewable energy production, sustainable infrastructure development, circular economy initiatives – that not only mitigate environmental degradation but also unlock economic and social benefits (ILO, 2008; Andor & Fels, 2018; Braga & Ernst, 2023).

From an economic standpoint, green jobs function as a critical catalyst for innovation and competitiveness. As Bowen & Kuralbayeva (2015) note in their study of labour market transformation within the European Union, green sectors, ranging from solar technology to eco-friendly manufacturing, are central to driving research and development, improving resource efficiency, and opening up new markets. They have the potential to revitalise regions that were once heavily dependent on fossil fuels, thus sparking regional growth and diversification (Fankhauser et al., 2008).

Green jobs also play an important role in promoting social equity (Görmüş, 2024). By providing access to employment opportunities, education, and training in emerging industries, they contribute to more inclusive labour markets. In this context, green human resource management emphasises the need to align workforce skills with evolving market demands and sustainability objectives (Renwick, Redman, & Maguire, 2013).

Research Problem

Despite the strategic importance of green jobs in European policy frameworks, significant challenges remain in translating these ambitions into consistent labour market outcomes. While initiatives such as the European Green Deal and the Just Transition Mechanism aim to foster both environmental sustainability and economic opportunity, the actual development of green employment remains uneven across sectors and regions.

Structural disparities between countries, differences in institutional capacity, and varying levels of economic development contribute to this uneven distribution. Moreover, the rapid expansion of green sectors has intensified the demand for specialised skills, while education and training systems struggle to keep pace with these changes (ILO, 2008). As a result, skill mismatches and workforce adaptation challenges persist.

In addition, although green jobs are widely promoted as a solution to unemployment and regional disparities, their measurement and classification remain inconsistent, making it difficult to assess their real impact on labour markets. These issues highlight a gap between policy objectives and implementation, raising questions about the effectiveness of current strategies in supporting a balanced and inclusive green transition.

Research Focus

In this context, the present study examines the role of green jobs in shaping the transformation of the European labour market. The analysis considers both policy frameworks and empirical developments, with particular attention to sectoral dynamics, regional disparities, and the evolving demand for green skills.

The study also explores how green jobs contribute to environmental sustainability, economic development, and social inclusion simultaneously. By integrating insights from policy analysis and labour market trends, the research aims to provide a comprehensive understanding of how green employment supports Europe's broader transition towards a sustainable and resilient economy.

Furthermore, particular attention is given to emerging sectors such as renewable energy and electric mobility, which illustrate the transformative potential of green employment (Sulich & Kozar, 2024). Key policy frameworks, such as the *European Green Deal* and the *Just Transition Mechanism*, highlight the dual goals of fostering environmental sustainability and creating economic opportunities. Studies by Gawel et al. (2014) emphasise the role of green jobs in enhancing Europe's

economic competitiveness while addressing systemic challenges like unemployment and regional disparities.

Research Aim and Questions

Given that the field of green jobs is still developing, this paper aims to present a comprehensive analysis of the current state and prospects of green jobs in Europe. The objective of this research is to *analyse the EU policies and strategies that promote the creation of green jobs to identify emerging sectors and the skills needed*.

In this paper, we aim to analyse policies and strategies in the field at the European level, and to continue a broader discourse on how green jobs can support Europe's transition to a sustainable, low-carbon economy while ensuring socio-economic inclusion. The key research questions are:

1. To what extent do EU strategies translate into measurable employment growth?
2. How do labour market trends align with policy goals, and what regional disparities exist?
3. What barriers hinder workforce reskilling and sectoral adaptation?

Literature review / Theoretical Overview

Green jobs, usually defined as roles that help preserve or restore environmental quality, include renewable energy, energy efficiency, sustainable agriculture, and green technology (Andor & Fels, 2018; ILO, 2008). A definition that evolves alongside advancements in sustainability-related technologies and practices is essential (Gawel et al., 2014). This aligns with the arguments of Fankhauser et al. (2008), who argue that innovations in energy storage, clean manufacturing, and the circular economy continually reshape the scope of green employment. Adopting a dynamic understanding of green jobs ensures their relevance to a transitioning economy and workforce.

Across the European Union, policy-driven efforts have catalysed employment in green sectors, particularly in renewable energy and energy efficiency (Bowen & Kuralbayeva, 2015). Germany's renewable energy expansion, which has reached over 387,000 employees in recent years, exemplifies how strong legislative and financial frameworks encourage job creation (Gawel et al., 2014). According to empirical research, green construction and eco-friendly product design are primed for substantial expansion, needing a workforce equipped with specialised skill sets (Renwick et al., 2013). Workforce readiness, including retraining for existing workers, is highlighted as a crucial factor in bridging the gap between emerging industries and a labour supply still oriented toward conventional sectors (Del Río & Carrillo-Hermosilla, 2007). Similarly, sustainable agriculture demonstrates potential to optimise land use while safeguarding ecosystems, thereby expanding employment opportunities for both skilled and lower-skilled workers (Renwick, Redman, & Maguire, 2013).

Green jobs can influence both economic growth and social well-being, as their expansion leads to new investments, technological innovations, and a reduction in fossil fuel use (ILO, 2008; Bowen & Kuralbayeva, 2015). An important impact is also their ability to revitalise local economies,

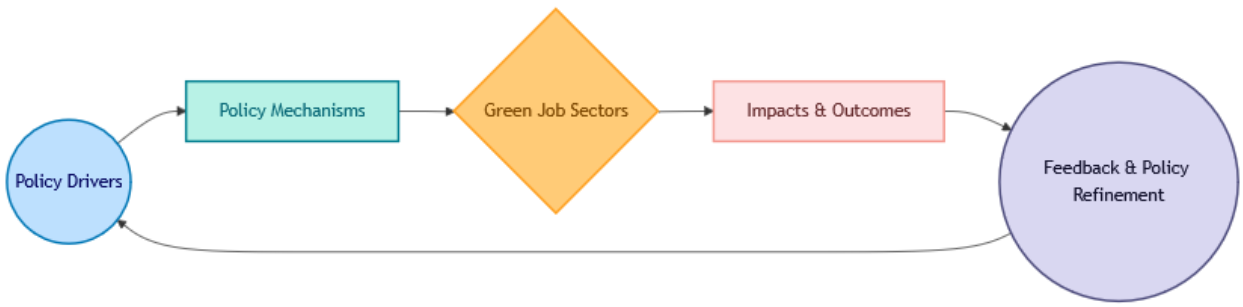
especially in regions affected by industrial decline (Fankhauser et al., 2008). For example, in the Spanish waste management sector, new recycling and composting initiatives have created employment opportunities, thereby reducing unemployment and improving environmental outcomes (Gawel et al., 2014). As these opportunities can benefit marginalised or transitioning groups, they serve as a channel for better inclusion in the labour market, supporting youth employment and gender equity (Renwick et al., 2013).

Strong environmental policies can support the growth of green jobs in Europe. The *European Green Deal* calls for significant changes to achieve climate neutrality by 2050, encouraging Member States to switch to renewable energy sources and invest in sustainable infrastructure. Legislative and financial instruments, such as subsidies and public-private partnerships, facilitate the workforce's transition to greener industries (Renwick et al., 2013). The *Just Transition Mechanism* (European Commission, 2020) aims to mitigate socio-economic imbalances by directing funds and resources to regions with carbon-intensive activities (Gawel et al., 2014; Emmerling et al., 2025). The foundation for the effective implementation of these measures is the development of education and skills policies that align employment opportunities with the knowledge required for a low-carbon economy (Del Río & Carrillo-Hermosilla, 2007). By developing the necessary human resources, the EU is positioning itself to achieve the wider economic, social and environmental benefits inherent in a green transformation of the workforce (Figuerola-Ferretti et al., 2025).

To illustrate how policies lead to practical mechanisms that influence multiple green job sectors and ultimately generate socio-economic and environmental benefits, Figure 1 below presents a conceptual diagram generated with the help of the Mermaid program. This figure visually illustrates the cyclical relationship between policy drivers (e.g. the European Green Deal, the Just Transition Mechanism), policy mechanisms (such as grants, skills programs and public-private partnerships), Green jobs sectors (renewable energy, energy efficiency, sustainable agriculture and green technology), impacts and outcomes (job creation, GDP growth, social inclusion and environmental sustainability) and feedback and policy refinement.

Figure 1

Conceptual Diagram of Green Job Ecosystems in Europe. Source: Authors' own research



Overall, the literature illustrates that well-structured policy frameworks—supported by targeted education and training—are instrumental in promoting the growth of green jobs. A holistic approach

that integrates environmental, economic, and social considerations ensures that the expansion of green employment yields sustainable development gains across Europe.

Research Methodology

General Background

To investigate the origins and growth of green employment in Europe, this study employs two interrelated methodologies: qualitative policy analysis through document analysis and secondary data analysis centred on labour market statistics. The need to capture both the goals of policy initiatives and the realities of employment as reflected in national and sectoral labour market statistics is reflected in the choice to focus on these two approaches. To gain a thorough grasp of complex social phenomena, researchers like Creswell (2014) and Tashakkori and Teddlie (2010) have argued for combining multiple research techniques. The developing field of green jobs is a prime example of the need to integrate multiple data sources and analytical tools.

Qualitative policy analysis through document analysis provides a way to understand how green employment has been framed, communicated, and justified at the European level. This approach centres on examining the substance of policy documents, strategy papers, and official statements to identify the objectives, priorities, and assumptions guiding Europe's sustainable transition. By analysing legislative texts, communications, and frameworks addressing green jobs, the study uncovers recurring themes and focal points that inform institutional agendas. Document analysis, as Bowen (2009) suggests, highlights not only explicit policy goals but also the underlying tensions or gaps within the discourse, revealing how strategies for green employment are formulated and justified. In doing so, it provides a tangible record of how policymakers conceive and advance sustainable practices across different economic sectors.

Participants / Sample

The study is based on a purposive sample of sixteen core policy documents selected for qualitative content analysis. These documents were chosen to represent the European Union's overarching legislative frameworks on environmental sustainability and workforce development. The sample includes regulations, directives, and strategic policy papers retrieved from EUR-Lex and official European Commission portals.

Each document was examined to assess the extent to which it explicitly addresses green jobs, skill formation, and economic inclusivity. Table 1 provides an overview of the selected documents, including their year of publication and their relevance to green employment.

Table 1

Core documents used for this research

DOCUMENT	ORGANIZATION	YEAR	FOCUS RELATED TO GREEN EMPLOYMENT
THE EUROPEAN GREEN DEAL	European Commission	2019	Establishes a roadmap for achieving climate neutrality by 2050; addresses green job

			creation in energy, transport, and industry while highlighting social fairness and economic growth.
JUST TRANSITION MECHANISM	European Commission	2020	Provides targeted financial and technical support to regions heavily reliant on fossil fuels or carbon-intensive industries; emphasizes worker retraining, job transition, and social equity measures.
FIT FOR 55	European Commission	2021	Proposes updated emissions-reduction targets and policy instruments; frames green employment within industrial innovation, competitiveness, and the need for specialized skills in emerging low-carbon sectors.
CIRCULAR ECONOMY ACTION PLAN	European Commission	2020	Focuses on product lifecycle approaches and waste reduction; explicitly mentions job opportunities in recycling, reuse, and eco-design, as well as skill requirements for new production models.
EU BIODIVERSITY STRATEGY FOR 2030	European Commission	2020	Advocates restoration of degraded ecosystems; signals job growth in nature conservation, sustainable agriculture, and ecotourism, underscoring rural development and skill-building.
FARM TO FORK STRATEGY	European Commission	2020	Aims to create a fair, healthy, and environmentally friendly food system; references job creation in organic and precision agriculture, sustainable supply chains, and supports farmer training initiatives.
ENERGY SYSTEM INTEGRATION STRATEGY	European Commission	2020	Endorses the integration of renewable energy networks, smarter grids, and green hydrogen; addresses employment shifts in energy infrastructure, energy storage, and system-wide R&D.
RENEWABLE ENERGY DIRECTIVE II (RECAST)	European Commission	2018 (amended 2021)	Sets binding targets for the share of renewables in EU energy consumption; notes employment benefits in installation, maintenance, and research, while highlighting the importance of training and certifications.
EU CLIMATE LAW	European Commission	2021	Enshrines the 2050 climate neutrality target into legislation; frames job creation as an integral part of decarbonization, linking long-term policy certainty to labor market planning.
EU ACTION PLAN FOR THE SOCIAL ECONOMY	European Commission	2021	Stresses social innovation and entrepreneurship; references green social enterprises and workforce inclusion, proposing measures to integrate environmental and social objectives in employment.

EUROPEAN SKILLS AGENDA	European Commission	2020	Seeks to boost the development of skills relevant to the green and digital transitions; includes objectives for upskilling and reskilling to match labor market needs in sustainability-oriented occupations.
A CLEAN PLANET FOR ALL (STRATEGIC LONG-TERM VISION)	European Commission	2018	Proposes a strategic vision for a climate-neutral economy by 2050; highlights the need for skill updates, new professional roles in low-emission technologies, and multi-level collaboration among stakeholders.
TAXONOMY REGULATION (REGULATION (EU) 2020/852)	European Commission	2020	Establishes a classification system for environmentally sustainable economic activities; implicitly references job creation in green finance, compliance, and sustainable project development.
REPOWEREU PLAN	European Commission	2022	Accelerates Europe's shift away from fossil fuels, focusing on renewables and energy savings; projects additional job openings in clean energy production, grid enhancement, and related innovation.
EUROPEAN PILLAR OF SOCIAL RIGHTS ACTION PLAN	European Commission	2021	Reinforces social fairness goals and includes commitments to inclusive growth and job creation, with green employment recognized as a catalyst for social equity in the labor market.
LULUCF REGULATION (REG. (EU) 2018/841 ON LAND USE)	European Commission	2018	Regulates land use, land-use change, and forestry to cut emissions and boost carbon removals; references expanding opportunities in forest management, monitoring, and sustainability services.

Source: Authors' development

Instrument and Procedures

The methodological approach combines qualitative content analysis of policy documents with the examination of secondary quantitative data sources. The qualitative component focuses on analysing key European policies and strategies related to green employment, low-carbon transition, and labour market transformation.

In parallel, the study incorporates labour market data from Eurostat, the OECD, and the International Labour Organisation (ILO). These datasets provide a quantitative perspective on green job creation, unemployment trends, and sectoral dynamics, enabling the assessment of whether policy objectives translate into measurable labour market outcomes.

For example, Eurostat data on employment in renewable energy and waste management between 2015 and 2022 indicate a gradual but consistent increase in green jobs in larger Member States such as Germany, Spain, and France, while smaller countries show more modest but

accelerating growth. OECD data contribute a macroeconomic perspective by linking green employment to indicators such as GDP, education levels, and R&D investment. Additionally, ILO data enrich the analysis by addressing dimensions such as job quality, worker mobility, and inclusivity in emerging green sectors.

The study also includes an in-depth review of selected key policies and strategies that directly address green employment and labour market transformation. Table 2 summarises these policies, outlining their institutional origins, adoption years, and core concepts.

Table 2

European policies and strategies

Policy/Strategy	Organization	Year	Key Concepts
European Green Deal	European Commission	2019	Climate neutrality by 2050, green job creation, sustainable growth
Just Transition Mechanism	European Commission	2020	Financial support for coal regions, reskilling, fair transition
Fit for 55	European Commission	2021	55% emission reduction target, renewable energy expansion, employment in low-carbon technologies
Circular Economy Action Plan	European Commission	2020	Waste reduction, product lifecycle, job creation in recycling and reuse
EU Biodiversity Strategy for 2030	European Commission	2020	Conservation jobs, ecosystem restoration, and sustainable land management

Source: Authors' development

These policy frameworks differ in their emphasis on economic competitiveness, environmental objectives, and social equity. While some, such as the European Green Deal, integrate multiple dimensions of sustainability and employment, others focus more specifically on regional transition, sectoral transformation, or skills development.

Data Analysis

The analysis adopts a mixed-methods approach, integrating qualitative and quantitative techniques to provide a comprehensive assessment of green employment dynamics in Europe.

Qualitative content analysis is used to examine how European policy documents frame and prioritise green jobs, skill development, and labour market transformation (Krippendorff, 2004). This approach enables the identification of key themes, policy orientations, and strategic priorities across documents.

At the same time, quantitative analysis is applied to labour market data using descriptive statistics and time-series analysis. Descriptive statistics are used to track trends in green job creation across countries and sectors, while time-series analysis examines how these trends evolve in relation to major policy milestones, such as the adoption of the European Green Deal.

This analytical framework builds on previous research (Bowen & Kuralbayeva, 2015), which highlights the importance of sector-level data in identifying emerging roles in low-carbon economies that may not be captured in aggregate statistics. Where discrepancies between policy ambitions and labour market outcomes are identified, additional analysis focuses on potential barriers, including financing constraints, governance limitations, and insufficient institutional support for workforce retraining.

By combining qualitative and quantitative evidence, the study employs a triangulation approach (Creswell, 2014; Bryman, 2012), enhancing the robustness and validity of the findings. This integration allows for a more nuanced understanding of the relationship between policy discourse and actual labour market developments, highlighting both progress and remaining challenges in the transition toward green employment in Europe.

Results

Given the scope of this research and the questions guiding this analysis, the anticipated results offer critical insights into how green employment policies and strategies translate into real labour market transformations across Europe. By systematically examining policy documents and labour market statistics, this study provides an empirical assessment of the alignment between policy goals and actual employment trends. Through a qualitative content analysis, the research identifies recurring themes in policy discourse, such as the prioritisation of renewable energy, circular economy initiatives, and green infrastructure as drivers of employment. Simultaneously, the quantitative analysis of labour market data highlights sector-specific job creation patterns, regional employment disparities, and the effectiveness of workforce reskilling programs. By integrating policy ambitions with statistical evidence, this study uncovers successes and gaps in Europe's transition toward a sustainable labour market, offering valuable recommendations to improve workforce adaptability, policy implementation, and the equitable distribution of green jobs across member states.

A. Key Sectors Driving Green Jobs

a) Renewable Energy

A major driver of green employment in Europe is the renewable energy sector (Bowen & Kuralbayeva, 2015). Policy documents such as the European Green Deal (European Commission, 2019) and national energy strategies emphasise the expansion of wind, solar and bioenergy infrastructure to meet the EU's climate neutrality objective by 2050. This is in line with Eurostat labour market data, which shows a persistent increase in employees working in renewable energy installation, operation and maintenance from 2018 to 2022. On the same note, countries such as Germany and Spain have seen notable growth in their onshore wind and solar photovoltaic (PV) industries (OECD, 2021).

Despite sustained efforts at the European level, growth patterns vary across Member States. While Germany's investments in wind and solar PV have led to a robust workforce, other EU countries

are experiencing slower job growth due to regulatory hurdles or limited financial incentives (Gawel et al., 2014; ILO, 2020). In regions with a history of coal use, the Just Transition Mechanism aims to reallocate workers to renewable energy roles, but labour market evidence suggests that success largely depends on local governance capacity and public-private partnerships. Without a regional strategy, the equitable distribution of renewable energy jobs remains elusive (Tashakkori & Teddlie, 2010).

b) Green Construction

Green construction is another significant source of potential green employment (Bowen & Kuralbayeva, 2015). Policy documents, including the Circular Economy Action Plan (European Commission, 2020a), highlight the need to reduce the carbon footprint of buildings. OECD labour force data illustrate that projects focused on energy-efficient retrofits and green materials create both skilled and semi-skilled jobs, such as architectural engineers and installation technicians. Examples of cities that have adopted strict building codes to encourage green retrofits and stimulate market demand for specialist contractors include Copenhagen and Vienna (Eurostat, 2021).

Despite progress, legislative objectives to modernise building standards are not always accompanied by clear guidance for workforce training. Although the European Green Deal refers to education and skills development, most operational details are delegated to national or local authorities (Bowen, 2009). As a result, some regions lack adequate training infrastructure, leading to a shortage of certified professionals to meet evolving energy-efficiency requirements. This disconnect hinders the pace of labour market transitions and poses a risk to achieving the environmental objectives underpinning EU policy.

c) Sustainable Agriculture

Sustainable agriculture aims to promote biodiversity and lower greenhouse gas emissions. The Farm to Fork Strategy (European Commission, 2020b) and the EU Biodiversity Strategy for 2030 (European Commission, 2020c) outline frameworks that support organic farming, resource-conserving practices and shorter supply chains. ILO data indicates an increase in agricultural roles related to organic certification, precision agriculture and alternative land management (ILO, 2020). These innovations help revitalise rural economies by diversifying job profiles and preventing rural depopulation.

Nevertheless, the text of these policies often stops short of detailing how to overcome economic or infrastructural barriers that limit widespread adoption (Bowen, 2009). The cost of achieving and maintaining organic certification can be prohibitive for smaller producers, despite EU subsidies intended to support them (OECD, 2021). Larger commercial farms tend to have greater resources to transition toward sustainability, occasionally resulting in uneven benefits across farming communities (European Commission, 2020b). Disparities in financial accessibility and infrastructure can thus complicate the labour market impact, even when policy narratives trumpet the potential for job creation in sustainable agriculture (Tashakkori & Teddlie, 2010).

d) Electric Mobility

Electric mobility is another growth sector driven by emissions standards (European Commission, 2019; Bowen & Kuralbayeva, 2015). The Fit for 55 document analysis indicates a trend of investment in electric vehicle (EV) production, battery research and development and charging networks. Corresponding employment data from Eurostat reveal an increase in jobs related to EV assembly, maintenance and charging infrastructure. Incentive programs, such as tax credits in Germany, France and the Netherlands, have stimulated consumer demand for electric vehicles, generating a parallel increase in jobs in production, service and specialised engineering for battery systems.

However, not all of Europe is aligning electric vehicle production with the pace of charging infrastructure development (OECD, 2021). This discrepancy may diminish job creation, as factory expansion depends on robust supply chains. Increasingly sophisticated skill requirements in areas such as battery diagnostics and electrical engineering pose additional challenges. While EU policy documents refer to skills-building programs (European Commission, 2019), labour market data suggest that specialist technical expertise is insufficient, slowing down the overall labour market transition in this area (ILO, 2020).

B. Evolving Demand for Green Skills

The shift towards renewable energy, green buildings, sustainable agriculture and electric mobility is increasing the need for specialist expertise (ILO, 2020). Policy communications in these sectors consistently highlight the importance of skills development for Europe's successful low-carbon transition (European Commission, 2019). OECD research finds that universities and vocational colleges are modifying curricula to include modules on clean energy engineering, waste management logistics and sustainable construction practices (OECD, 2021). Collaborative programs between private industry and educational institutions add an applied dimension, potentially bridging the gap between academic theory and workplace realities.

Despite these initiatives, the pace of technological innovation can outstrip the capacity of educational systems to reform curriculum or credentialing processes. Rapid developments in offshore wind equipment, advanced building materials, and software-driven farming methods can render skill sets outdated if workers lack consistent continuing education opportunities (Tashakkori & Teddlie, 2010). Regional disparities also remain critical. Areas heavily dependent on heavy manufacturing or extractive industries lag behind in development, even when policies are in place that emphasise just and equitable transitions (European Commission, 2020). This inequality can pose challenges for labour mobility and regional competitiveness.

C. Reskilling and Upskilling

Retraining and upskilling efforts are essential to ensure that Europe's existing workforce can adapt to emerging green sectors. The Just Transition Mechanism is a prominent policy instrument designed to support communities previously dependent on fossil fuels. Evidence from the ILO Green Jobs Program shows that well-structured reskilling initiatives can be successful when supported by strong public-private partnerships and local governance programs (ILO, 2020). In such

cases, reskilling can enable the mobility of coal workers into wind farm construction, solar panel manufacturing or green technology roles. However, results are mixed across regions, reflecting variations in program design, funding consistency and the involvement of educational institutions.

EU policy discourse often invokes the principle of „lifelong learning", reflecting the recognition that a single retraining course may not be sufficient (European Commission, 2019). However, some training programs depend on short-term pilot schemes that are contingent on fluctuating external funding or politically sensitive budget allocations. The success of these programs may be limited in the long run if solid governmental frameworks are not in place to encourage the private sector to hire retrained individuals (Bowen, 2009). Sustained results necessitate ongoing adaptation, such as strong apprenticeship programs, subsidies for skill development, and sectoral cooperation, a paradigm promoted by Tashakkori and Teddlie (2010) for tackling complex societal issues.

Discussion

A recurring observation is the scarcity of longitudinal, disaggregated data that assess the inclusivity and durability of green job initiatives (Eurostat, 2021). Although the OECD and Eurostat provide indicators on employment and sectoral growth (OECD, 2021), these metrics do not always capture migration patterns, career trajectories, or demographic breakdowns. The absence of universally valid metrics makes it difficult to determine whether green opportunities are equally accessible across social groups (ILO, 2020).

Definitional ambiguity complicates tracking and comparing green jobs. Some datasets include direct environmental roles (e.g., solar panel installers), while others include indirect or support positions. The ILO has proposed guidelines for standardising these definitions (ILO, 2020), but the application of a universal metric remains slow. Without consistent baseline measurements, policy evaluation becomes challenging—especially given the continuous emergence of new roles in digital, engineering, and research capacities linked to sustainable transitions (European Commission, 2020).

One underexplored dimension concerns how newly formed green roles integrate into broader labour markets. Electric mobility, for example, increasingly intersects with software development and data analytics (OECD, 2021). Similarly, the supply chain for energy-efficient housing involves finance, marketing, and legal compliance experts. These intersections require cross-sectoral policies, yet policy texts seldom elaborate strategies for inter-industry collaboration (European Commission, 2019). Further research on labour market permeability could clarify how best to empower workers transitioning from conventional industries to multidisciplinary green roles (Bowen & Kuralbayeva, 2015).

Europe's green employment prospects operate within a global context that includes competing regulatory regimes and labour cost disparities (ILO, 2020; Uche et al., 2025). While the European Green Deal aspires to leadership in sustainable industries, offshoring or supply chain dependencies may limit domestic job creation. Data sets from the OECD track some cross-border flows, but in-depth comparative research is often missing, hindering a comprehensive understanding of how Europe's local interventions measure up against broader global dynamics.

Despite encouraging trends, various barriers could hinder the expansion of green jobs. Regulatory constraints, such as stringent permitting processes for new wind farms or solar plants, can prevent investment (European Commission, 2020a). High reskilling costs also remain problematic, especially in economically fragile regions coping with industrial decline (ILO, 2020; Cook & Elliott, 2025). Market readiness for nascent technologies—like hydrogen fuel cells—may be tepid without substantial policy-driven incentives. Yet a host of opportunities emerges if these barriers are addressed. Growth in advanced energy storage, digital platforms for waste management, and climate-resilient agriculture could propel a new wave of green innovation, potentially creating specialised roles across supply chains (Bowen & Kuralbayeva, 2015).

The European Green Deal, along with complementary policy packages (European Commission, 2019; 2021), continues to serve as a linchpin for coordinating employment and climate objectives. OECD labour market reviews (OECD, 2021) point out that stable and predictable regulatory environments can attract capital to sustainable sectors, thereby multiplying job-creation effects. Over time, national vocational frameworks aimed at lifelong learning—emphasised in EU communications (European Commission, 2020)—could help align the supply of workers with these expanding industries. However, consistent funding, stakeholder engagement, and political resolve are prerequisites for bridging implementation gaps at the local level (Bowen, 2009).

Three drivers consistently emerge from the analysis: education, innovation, and regulation. This is sustained by the study of Tashakkori & Teddlie (2010). Educational systems, from primary school to higher education, must rapidly integrate environmental teaching and technical skill-building modules for emerging industries. Innovation, strengthened by public and private research investments, catalyses the development of new products and methods that create specialised roles across the green economy (OECD, 2021). Regulation, when stable and forward-looking, reduces uncertainty in green markets and encourages the private sector to invest in workforce development (European Commission, 2019). Demographic changes, including ageing populations in parts of Europe, add another layer of complexity to labour supply. Policymakers may need to consider strategies for worker mobility or international recruitment to ensure a robust talent pool.

In sum, the results and discussions presented here underscore the multifaceted nature of Europe's green job landscape. Sectors such as renewable energy, green construction, sustainable agriculture, and electric mobility demonstrate the potential for substantial employment growth, albeit at different paces and with heterogeneous regional distributions (Eurostat, 2021; ILO, 2020; OECD, 2021). The research also reveals a persistently evolving demand for green skills, along with vital reskilling efforts that can enable workers to transition from carbon-intensive industries. While policy frameworks such as the European Green Deal and the Just Transition Mechanism have undeniably accelerated progress, significant gaps remain in accurately measuring green jobs, evaluating long-term inclusivity, and ensuring cross-sector integration. It will take consistent dedication to comprehensive workforce development, strong collaborations between the commercial sector and educational providers, and ongoing policy improvement to overcome these obstacles. Building on the analysis's findings, future research should pay special attention to standardising green job definitions, collecting longitudinal data, and conducting comparative

studies that situate Europe's green employment practices within the framework of international economic competitiveness.

Conclusions and Implications

The conclusions presented in this article, based on both policy analysis and empirical labour market evidence, highlight the critical role of green jobs in achieving Europe's sustainability goal. Drawing on scholarly insights and methodological frameworks, the discussion has identified specific strategies and challenges that define the current and future landscape of green employment in Europe.

Green jobs have emerged as a key component of Europe's response to climate change and resource constraints, reflecting policy commitments such as the European Green Deal and the Just Transition Mechanism. These frameworks underscore the need to align decarbonization objectives with labour market stability and social inclusion (Gawel et al., 2014; Del Río & Carrillo-Hermosilla, 2007). However, rapid growth in sectors including renewable energy, green construction, sustainable agriculture, and electric mobility (Bowen & Kuralbayeva, 2015; Fankhauser et al., 2008) demands an equally robust expansion in workforce competencies. As research has shown, emerging skill requirements necessitate reskilling and upskilling programs (Renwick et al., 2011), especially in regions transitioning away from fossil-fuel-based economies (ILO, 2020). Addressing these needs is fundamental in achieving an equitable, job-rich transition.

First, stable legislative incentives, financial mechanisms, and well-coordinated public-private partnerships should be used to promote innovation and cross-sector collaboration (Andor & Fels, 2018; Renwick et al., 2013). This will ensure that a flexible workforce can keep pace with advancements in fields such as sustainable supply chains and innovative energy technologies. Second, for workers to learn the evolving technical and soft skills required in green sectors, education and training demand substantial investment at all levels, from university curricula to vocational programs (Del Río & Carrillo-Hermosilla, 2007; Renwick et al., 2011). Third, carefully planned interventions that focus on underserved or highly industrialised areas are necessary to address inclusion and regional inequities. These projects can be made more equitable and effective by aligning them with larger EU procedures.

While recent policy changes and labour market adjustments appear to be motivating, two key areas require analysis. Further investigation is needed to understand the long-term socio-economic implications of green jobs at the regional and community levels, including how new types of employment affect social mobility, wage dynamics, and intergenerational equity (Del Río & Carrillo-Hermosilla, 2007; Tashakkori & Teddlie, 2010). Such longitudinal research could reveal whether current policies support long-term growth or aggravate inequities. Second, strengthening measurement frameworks for green jobs is a continuous task (ILO, 2020). A uniform framework that encompasses both direct and indirect functions in the green economy would allow for more precise cross-country comparisons and evaluations of policy efficacy. Improved tracking of demographic data could also shed light on how inclusion goals correlate with actual employment outcomes.

The paper highlights the multidimensional nature of Europe's green labour market transformation by combining policy discourse, labour market data and academic studies. By prioritising innovative policy frameworks, education and training and equitable regional development, EU member states can strengthen the role of green jobs as a key instrument for achieving climate objectives while sustaining economic growth and social cohesion. As Europe navigates this transformation, sustained attention to emergent challenges and systematic investment in human capital will shape the long-term success of the green economy.

Suggestions for Future Research

The research should also look more deeply into the long-term dynamics and inclusiveness of green employment in European labour markets in the future. Among these paths is the emergence of longitudinal studies to track the workforce changes over time, which will enable a deeper analysis of career mobility, job stability and the viability of green employment opportunities. These strategies would assist in evaluating whether existing policy frameworks bring sustainable labour market changes or short-term impacts on employment.

The other important avenue is the standardisation of the definition of green jobs and measurement frameworks. The unavailability of the same metrics across datasets limits cross-country comparisons and reduces the accuracy of policy assessment. Future researchers might help formulate harmonised indicators that reflect both direct and indirect green employment and qualitative aspects such as job quality and inclusiveness.

More studies are also required regarding cross-sectoral integration, specifically the nexus between green jobs and digital transformation. With the increasing integration of environmental and technological capabilities into emerging sectors, it is important to understand how skills, jobs and industries intersect. Future research could benefit from extensive panel data, allowing analysts to track workforce transitions over long periods.

Last but not least, comparative international studies would offer a useful input in the performance of the European methods of green employment against other parts of the world, with an aim of determining the best practices and how the policies can be designed to fit an increasingly competitive and interconnected global economy.

Acknowledgements

None

Conflict of Interest

The authors declare no conflict of interest.

Funding

The authors received no funding for this research.

References

Andor, M., & Fels, K. M. (2018). Green growth, green jobs and labor markets. *Journal of Environment & Development*, *27*(2), 167–195. https://doi.org/10.1177/1070496518774315

Bowen, A., & Kuralbayeva, K. (2015). *Looking for green jobs: The impact of green growth on employment* (Grantham Research Institute on Climate Change and the Environment Working Paper No. 92). London School of Economics and Political Science. https://doi.org/10.2139/ssrn.2561239

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27–40. https://doi.org/10.3316/QRJ0902027

Braga, J. P., & Ernst, E. (2023). Financing the green transition: The role of macro-economic policies in ensuring a just transition. *Frontiers in Climate*, *5*. https://doi.org/10.3389/fclim.2023.1192706

Bryman, A. (2012). *Social research methods* (4th ed.). Oxford University Press.

Cook, T., & Elliott, D. (2025). Green skills gap—A way ahead. *Frontiers in Sociology*, *10*. https://doi.org/10.3389/fsoc.2025.1577037

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.

Del Río, P., & Carrillo-Hermosilla, J. (2007). Policy strategies to promote eco-innovation: An integrated framework. *Journal of Industrial Ecology*, *11*(3), 133–146. https://doi.org/10.1162/jiec.2007.1170

Denyer, D., & Tranfield, D. (2009). Producing a systematic review. In D. A. Buchanan & A. Bryman (Eds.), *The SAGE handbook of organizational research methods* (pp. 671–689). SAGE Publications.

Emmerling, J., Drouet, L., Jewell, J., Nacke, L., Pai, S., & Zerriffi, H. (2025). Green jobs and just transition: Employment implications of Europe's Net Zero pathway. *Energy Research and Social Science*, *127*. https://doi.org/10.1016/j.erss.2025.104292

European Commission. (2018a). *A clean planet for all: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy* (COM(2018) 773 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0773

European Commission. (2018b). *Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (recast)*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018L2001

European Commission. (2018c). *Regulation (EU) 2018/841 of the European Parliament and of the Council on the inclusion of greenhouse gas emissions and removals from land use, land-use*

change, and forestry in the 2030 climate and energy framework. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018R0841

European Commission. (2019). *The European Green Deal*. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

European Commission. (2020a). *A new circular economy action plan: For a cleaner and more competitive Europe*. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN

European Commission. (2020b). *EU biodiversity strategy for 2030: Bringing nature back into our lives*. https://ec.europa.eu/environment/nature/biodiversity/strategy_2030/

European Commission. (2020c). *European skills agenda for sustainable competitiveness, social fairness and resilience* (COM(2020) 274 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0274

European Commission. (2020d). *A farm to fork strategy for a fair, healthy and environmentally-friendly food system*. https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

European Commission. (2020e). *The just transition mechanism: Making sure no one is left behind*. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/just-transition-mechanism_en

European Commission. (2020f). *Powering a climate-neutral economy: An EU strategy for energy system integration* (COM(2020) 299 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0299

European Commission. (2020g). *Regulation (EU) 2020/852 of the European Parliament and of the Council on the establishment of a framework to facilitate sustainable investment (Taxonomy Regulation)*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32020R0852

European Commission. (2020h). *Sustainable Europe investment plan: European Green Deal investment plan* (COM(2020) 21 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0021

European Commission. (2021a). *Building an economy that works for people: An action plan for the social economy* (COM(2021) 778 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0778

European Commission. (2021b). *The European pillar of social rights action plan* (COM(2021) 102 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0102

European Commission. (2021c). *"Fit for 55": Delivering the EU's 2030 climate target on the way to climate neutrality*. https://ec.europa.eu/clima/eu-action/european-green-deal/delivering-european-green-deal_en

European Commission. (2021d). *Regulation (EU) 2021/1119 of the European Parliament and of the Council establishing the framework for achieving climate neutrality (European Climate Law)*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1119

European Commission. (2022). *REPowerEU plan* (COM(2022) 230 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022DC0230

Eurostat. (2021). *Renewable energy statistics*. https://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics

Eurostat. (2023). *Renewable energy statistics*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics

Fankhauser, S., Sehlleier, F., & Stern, N. (2008). Climate change, innovation and jobs. *Climate Policy*, *8*(4), 421–429. https://doi.org/10.3763/cpol.2008.0513

Figuerola-Ferretti, I., Lumbreras, S., Paraskevas, P., & Paraskevopoulos, I. (2025). Sustainability in action: Macro-level evidence from Europe (2008–2023) on ESG, green employment, and SDG-aligned economic performance. *Sustainability*, *17*(20). https://doi.org/10.3390/su17209103

Gawel, E., Strunz, S., & Lehmann, P. (2014). A public choice view on the climate and energy policy mix in the EU: How do the emissions trading scheme and support for renewable energies interact? *Energy Policy*, *64*, 175–182. https://doi.org/10.1016/j.enpol.2013.09.008

Görmüş, A. (2024). Employment policies for 'just transition' to green economy. *Memleket: Siyaset ve Yönetim*, *19*(42). https://doi.org/10.56524/msydergi.1437738

International Labour Organization. (2008). *Green jobs: Towards decent work in a sustainable, low-carbon world*. https://www.ilo.org/global/topics/green-jobs/publications/lang--en/index.htm

International Labour Organization. (2020). *Green Jobs Programme: Country brief*. https://www.ilo.org/global/topics/green-jobs/lang--en/index.htm

International Labour Organization. (2023). *Green jobs: Promoting decent work in a sustainable, low-carbon world*. https://www.ilo.org/global/topics/green-jobs/lang--en/index.htm

Jackson, S. E., Renwick, D. W. S., Jabbour, C. J. C., & Muller-Camen, M. (2011). State-of-the-art and future directions for green human resource management: Introduction to the special issue. *Zeitschrift für Personalforschung*, *25*(2), 99–116. https://doi.org/10.1688/1862-0000_zfP_2011_02_Jackson

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology* (2nd ed.). SAGE Publications.

OECD. (2023a). *Green growth indicators*. https://stats.oecd.org/Index.aspx?DataSetCode=GREEN_GROWTH

OECD. (2023b). *Labour market statistics on green jobs*. https://www.oecd.org/environment/green-economy/

Renwick, D. W. S., Redman, T., & Maguire, S. (2013). Green human resource management: A review and research agenda. *International Journal of Management Reviews*, *15*(1), 1–14. https://doi.org/10.1111/j.1468-2370.2011.00328.x

Sulich, A., & Kozar, Ł. J. (2024). Green economy and energy: Green labor market elements identification. *Journal of Infrastructure, Policy and Development*, *8*(6). https://doi.org/10.24294/jipd.v8i6.4953

Tashakkori, A., & Teddlie, C. (2010). *Mixed methods in social & behavioral research* (2nd ed.). SAGE Publications.

Uche, E., Ngepah, N., & Haron, N. F. (2025). Paving the way for sustainable green growth in G10 economies: Perspectives on green manufacturing employment and renewable energy employment. *Sustainable Futures*, *9*. https://doi.org/10.1016/j.sftr.2025.100780

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, *26*(2), xiii–xxiii. https://www.jstor.org/stable/4132319