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Green Jobs: Barriers and Drivers in the EU

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ABSTRACT There are many barriers to green job expansion in the EU linked to cultural, economic barriers, organizational, political, technological technical, social, and behavioral barriers. The main drivers of green job creation include social norms and rules, governance policies, cultural values, demographic data, socio-economic inclusion, technical, and technological elements, etc. The aim of this paper is to analyze barriers and drivers that can influence green job expansion. The case study on green jobs expansion in the EU is provided based on statistical data from EUROSTAT. The policies and measures aiming to cope with barriers to green job expansion and support drivers of these processes are recommended for EU countries based on research conducted.

KEY WORDS: transformative changes; carbon neutral society; barriers, drivers, policies, and measures.

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1. Introduction

The transition to a decarbonized economy is important not only due to addressing climate change but also as a driver of economic growth and competitiveness with the potential to create millions of green jobs and provide important social, environmental, and economic benefits to society (Liu & Liu, 2023; Wu & You, 2022). Green jobs can directly protect the environment or seek to minimize negative environmental impact, save resources, and restore ecosystems.

There is also a large body of scientific literature linked to green job competencies. According to International Labor Organization (ILO, 2021), green skills comprise technical knowledge and expertise that allow using green technologies and processes on occupation sites. The importance of knowledge, values, and attitudes for environmentally sustainable decision-making at work was also stressed in this study. The ILO (2023) report stressed that the transition to a carbon-neutral and more digital – society will overturn the job market and generate demand for green skills within sectors and jobs. The report by Cedefop (2021) develops scenarios for understanding the European Green Deal (EGD) implications for occupation and skills. The report's findings provided the sectoral and occupational shifts at the EU for the development of future-oriented vocational training and skills policies. Studies (Cedefop, 2021; da Silva et al., 2022; ILO, 2023; Mingaleva & Vukic, 2020; Polonen, 2021; Rodriges Martinez et al., 2021) stressed that skilling, reskilling, and upskilling throughout humans' living is es-

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sential, and the prioritization of skills and empowering people from a lifelong learning perspective are necessary to ensure decent work opportunities. There is no agreement in the increasing number of studies on how green transition governance and green jobs can be realized and duly promoted.

This paper aims to overcome this gap and is dedicated to a comprehensive analysis of barriers and drivers that can influence green job expansion. The policies and measures aiming to cope with barriers to green job expansion and support drivers of these processes are discussed.

The paper is organized in the following way: in the following section, the background of the study is provided; in the third section, methods and data are described; in the fourth section the barriers to green jobs are systematized; in the fifth section drivers of green jobs are explored, in sixth section case study on green jobs penetration in EU countries is provided and in seventh section conclusions and policies and measures are developed to cope with barriers and support drivers of green jobs creation in EU.

2. The Background of the Study

Among the key economic drivers of the 21st century will be the conceptualization of pairing green jobs, since employment can contribute to environmental protection and carbon footprint reduction from humanity's activities. Subsequently, the "climate-proofing" of the global economy term is defined as devoting large-scale investments in new technologies and their equipment, as well as in buildings and infrastructure, providing a major stimulus for the most suitable and needful new positions of employment and the opportunity of existing jobs to be either retained or transformed (Renner et al., 2008).

In the agricultural sector, the key priority aspects are the increase of water efficiency, prevention of erosion, plantation of trees, conservation tillage utilization, as well as rehabilitation of degraded crops and pastureland to further support the living conditions of rural populations. All these efforts can be synergistic to adapt farming to severe climate changes and to protect croplands from environmental degradation (Renner et al., 2008).

While there is an imperative need for stead economic transformation among contemporary societies, enterprises, workers and governments should play a key protagonist role in such a great transformation. This transformation embodies essential agents of change in developing new ways of working in sustainable enterprises, environmental safeguarding, and decent job creation that can further support the social inclusion of today's (socio-economically) marginalized and vulnerable population. Therefore, research works can focus on the world of labor opportunities and transformations, highlighting those solutions, policies, and practices for tackling climate change, achieving long-term environmental sustainability, and even more, building societies with prosperous and cohesive perspectives (Poschen, 2017).

Authors (McNamara et al., 2008) stressed that key stakeholders can put efforts at working together in order to provide better information, guidance, education, and training to "hardwire" the sustainability agenda across all components of education and training processes. Green job competencies include many new skills, like resilience, innovativeness, creativity, and technical and soft skills (Belchior-Rocha et al., 2022; Horvathova et al., 2022; Joynes & Rossignoli, 2019; Ritter et al., 2018; Saniuk et al., 2022).

Green job planning can support policymakers and businesses to implement strategies inspired by the disciplines of circular economy and to make informed decisions that promote sustainable growth and employment (Bytyqi et al., 2023).

Similar studies demonstrated that future research can be focused on green job creation in the energy sector (Kozar & Sulich, 2023). Indeed, a green transition from conventional fossil fuels towards renewable energy sources in the energy sector is a realistic technological change that can also influence green job creation (Kozar & Sulich, 2023). At this point, it is noteworthy that the relevant research is anticipated to determine the current knowledge as well as the predicted evolution of green jobs in the energy sector since this type of knowledge can be useful for both scientists and practitioners (Kozar & Sulich, 2023).

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Research into green jobs is currently related to the rise of the green economy jointly with the effects of this new type of green employment to offer new working opportunities. For this, current academic literature should shift the research focus from the consequences of green policies and green jobs towards the stimulation of employment growth. At this point, it is important to identify enablers that could assist policymakers and local stakeholders in designing future programs and actions aimed at local development in areas with similar conditions .Besides, the identification of constraints, barriers, and limitations of green jobs remains a challenging issue of future and constant investigation (Battaglia et al., 2018)

Green jobs cannot be seen as a separate activity from the other socio-economic agents of economic growth. For this, green jobs are an inseparable part of businesses' performance through collaborative networks, making necessary local governments to seek and ensure that optimal patterns and positions are offered under conditions of predictability and acceptable collaboration costs, rather than making provision to simply scale up the quantity and the quality of collective efforts (Kwak & Feiock, 2023).

A similar study was focused on the subset of firms related to green products and services, revealing some idiosyncratic features and drawing the future research directions on developing green skills, competencies, and jobs in firms, while re-regulating the relevant market rules and the applied policy levers (Cecere & Mazzanti, 2017)

The definition and the operation of green jobs is a debatable issue about what constitutes our everyday practice of green livelihoods. This side of green jobs is most striking in poor urban societies thus, research should present experiences from fieldwork in fast economically developing countries, like Egypt, Nigeria, and Kenya. Such green job cases can provide practical examples of how and to what extent communities are pursuing strategies for jointly achieving income safety, community empowerment, and environmental preservation (Acey & Culhane, 2013).

Based on the aforementioned introductory overview, but from the green jobs point of view in real-world applications, it can be argued that green jobs sustain immense dynamics. However, this developmental opportunity for green jobs has to be materialized only through massive and sustained investments on behalf of both the public and the private sectors. The establishment of greening all aspects of the economy is (or should be) a central governmental policy that can be envisaged under clearly defined targets and mandates, considering all business incentives, as well as reformed policies on tax and subsidy. Moreover, it is crucial for the development of innovative forms of technology transfer towards a more globalized perspective, offering the spread and adoption of green methods at such a necessary scale and speed that could avoid full-fledged climate change (Renner et al., 2008).

In addition, authors (Afolabi et al., 2018) stressed that the unique qualities of women can make them bearers to find feasible solutions for sustainability and simultaneously dealing with climate change's identified dangers; nevertheless, green growth opens many opportunities for women in green jobs market though there are several important barriers for them to enter this highly technical jobs market.

A study by Falxa-Raymond et al. (2013) showed that positive environmental attitudes and behaviors can be recognized by individuals, as the logical consequence of green jobs training and employment. According to Braun et al. (2022), barriers and facilitators can be directed to engage and adhere to guided internet-based interventions to disclose the convergence between green-centered jobs and health complications. In this study, authors examined the case of preventing depression and reducing pain-related disability in green professions following mixed methods research (Braun et al., 2022).

Therefore, though there are very good opportunities for green job creation and expansion due to green growth policies promoting green growth, development, and use of renewable energy sources there is big not realized potential for new green jobs and green employment due to many barriers still available. Therefore it is important to analyze and systematise barriers to green job

creation and to define and map the main policies and measures aiming to cope with these barriers and unlock the potential of green job growth in the EU.

3. Approach and Methods

The main approach followed in this paper is the review of barriers and drivers of green job expansion to systematize policies and measures targeting these barriers and strengthening drivers.

The main methods applied are analysis and synthesis and qualitative assessment of barriers and drivers of green jobs based on the results of recent scientific research conducted in this field. Therefore, the qualitative research method was applied for the analysis of the main barriers and drivers.

In addition, the case study on green jobs penetration in the EU was conducted based on statistical data.

4. Barriers to Green Jobs

The main barriers to green job expansion are summarized in the following areas: cultural barriers, economic barriers, governance and organizational barriers, technological and technical barriers, social and behavioral barriers, and so on.

A detailed explanation of those barriers is provided in Table 1.

Table 1

Barriers to Green Job Expansion

Types of barriers	The main barriers	References
Cultural barriers	Green jobs in other, than renewable energy, sectors green jobs are challenging to conform to and confront hurdles in investment technology, agriculture, labor market, and urbanization.	Sweeney et al., 2009
Cultural barriers	This research denoted the difficulty of finding a precise definition of green jobs as well as the whole range of green job professions. Besides, it is difficult to predict the precise number of labor workforce that is currently engaged or to be engaged in the future, in green jobs. However, this is an early research constraint (at the time of publication, almost a decade ago).	Bernat, 2012.
Cultural barriers	Besides to immense relevance of RICS members' work to sustainability, there was a lack of knowledge and expertise to effectively implement a combination of sustainability-centered information and tools.	McNamara et al., 2008
Economic barriers Entrepreneurial barriers	Among the obstacles/factors to implementing resource-efficiency actions is the lack of environmental expertise. On a regional level there are reported differences among European countries and on a business level there are heterogeneity differences across firms. There is not an adequate population of workers who are dedicated to green jobs, while green jobs are strongly associated with the potential to adopt resource-efficiency practices.	Bassi & Guidolin, 2021
Economic barriers Entrepreneurial barriers	There is sparse research production in the field of circular economy impacting on firm-level employment.	Bytyqi et al., 2023
Governance and organizational barriers	There is a research gap between theory and practice: green jobs definition and green self-employment.	Kozar & Sulich, 2023

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Table 1

Barriers to Green Job Expansion (Continued)

Types of barriers	The main barriers	References
Governance and organizational barriers	Impeding factors of green job creation and local green business development are considered the bureaucracy and the lack of infrastructural investments.	Battaglia et al., 2018
Governance and organizational barriers	Over-time high-cost mechanisms aim at reducing commitment to collaboration or leading to a partially connected collaboration.	Kwak & Feiock, 2023
Governance and organizational barriers	Focusing on a large-scale green jobs agenda in high-income countries can obscure the ways in which small-scale technologies can be a transformative source of employment among developing economies.	Acey & Culhane, 2013
Governance and organizational barriers	There is a difficulty in determining uniform methods to measure or to forecast the effects of green jobs' creation which could serve as indicators for future research directions.	Sulich & Sołoducho-Pelc, 2022
Social and behavioral barriers	There are identified barriers in applying socio-economic benefits and guiding policies of women's inclusion in green jobs: actions that can be taken to attract, retain, and explore women's capabilities (in green jobs).	Afolabi et al., 2018
Social and behavioral barriers	In the education sector and the long-life learning policies among economically disadvantaged young adults, there are significant challenges facing training program graduates and their supervisors. However, there are also benefits of urban conservation job training and employment that are potentially transformational among the aforementioned group age of education.	Falxa-Raymond et al., 2013
Social and behavioral barriers	Social workers as by nature an environmentally friendly profession. However, there is a thread of failing to incorporate ecological issues in the United States and abroad, thus, social workers can play a pivotal role in understanding the linkages between people and the environment, the integration of environmental issues into social work practice, as well as the advocate for vulnerable populations.	Shaw, 2013
Social and behavioral barriers	Education, training, and skill-building programs for green jobs can be expanded to cover a broad range of occupations. For this, green jobs can be attributed primarily as decent jobs that offer noticeable competitive advantages (which is not always the case today), including competitive wages and income security, safety in the working environment, work dignity, and appreciation/deserve/respect of workers' rights. Green jobs occasionally involve serious occupational health hazards and simultaneously generate less than living wages and incomes. Besides, recycling work may be sometimes precarious. Agricultural-related green jobs, such as those of growing crops at biofuel plantations in the developing countries of Brazil, Colombia, Malaysia, and Indonesia often involve excessive workloads, jointly with poor pay, pesticide exposure, and workers' oppression. These constraints signify the role of sustainable employment to serve as a beneficial factor for both the environment and those people/labor workforce holding the jobs. It is noteworthy that it is eminently possible to envisage an economy that reconciles human aspirations with the planet's limits/capacities. While at a global level, there are many billions of jobs that focus on recycling and remanufacturing, incompatible definitions and a lack of collected data make impossible the conclusion of affirmative statements on a generalized basis of applicability.	Renner et al., 2008

Table 1
Barriers to Green Job Expansion (Continued)

Types of barriers	The main barriers	References
Social and behavioral barriers	-Small farms are predominately characterized as labor- and knowledge-intensive compared to agro-industrial farms, showing also use of fewer energy and chemical inputs. On the other hand, relatively sustainable forms of smallholder agriculture have to confront challenges imposed by energy specifications, pesticide regulations, and global supply chains. -A wide plethora of jobs are determined by the creation of planting trees, although these are often seasonal and low-paid.	Renner et al., 2008
Health-Occupational barriers	Green professions, mainly involving agriculturists, horticulturists, and foresters, are subjected to increased vulnerability in medical malfunctions and disorders, the most detectable of which are chronic pain and other risk factors for mental complexities.	Terhorst et al., 2020
Health-Occupational barriers	In this study, the entity of long-term stability for positive mental health effects of internet-based interventions (IBIs) for depression prevention was introduced. It was denoted that while IBIs are still scarce, there are necessary programs for depression prevention in green professions to be scheduled for long-term effectiveness (i.e., agriculture, horticulture, forestry), to be indicated in green professions.	Braun et al., 2021a
Health-Occupational barriers	In this study the impact of Major Depressive Disorder (MDD) on public health was demonstrated, considering the evaluation of an online prevention measure to be undertaken as part of a national project devoted to reducing depression in the occupational group of green professions. -A barrier in that research is the limited number of green professions as well as the limited representativeness restrictions imposed by the self-selection of participants. Online prevention measures can confront and reduce the depression burden reported in green professions. Yet, low adherence rates can moderate and lower the short-term effectiveness of such types of measures.	Braun et al., 2021b

5. Drivers of Green Job Expansion

There are four drivers (technological innovations, political economy redistribution, new narratives, and transformative learning that can interfere at diverse points of the systems and encourage changes based on the Meadows concept (2008). The drivers of green jobs expansion are described in Table 2.

6. Case Study on Green Job Expansion in the EU

There are several indicators used to monitor green job expansion. The indicator Employment in the environmental goods and service sector displays information on the employment situation in the environmental (or green) economy sector and is used widely by the European Environment Agency (2024). This indicator is based on Eurostat statistics on employment and European environmental goods and service sector (EGSS) accounts. This sector covers activities and products provision for environmental protection or resource management. Environmental protection accomplishments target pollution reduction and prevention of environmental degradation. Resource management undertakings target natural resource preservation. The data on employment in the environmental goods and service sector in 2014 and 2020 is provided for EU-27 MS in Figure 1.

As one can see from Figure 1, the shares of employment in the environmental goods and services sectors have increased from 2014 to 2020 in all EU

Table 2

Drivers of Transformative Change Towards Carbon Neutrality

Types of drivers	The main drivers	References
Cultural drivers	A key economic driver of green jobs globally is that of sustainable economy. This term can step forward into developing the largely uncharted fields of sustainable and low-carbon global economy. However, a clear definition and understanding of the opportunities and challenges is also required for such a sustainable economy attainment.	Poschen, 2017
Cultural drivers	There is a highly likely growing trend in green jobs in renewable	Sweeney et al., 2009
Cultural drivers	Green jobs can shape the future paths of economic prosperity and environmental sustainability.	O'Gorman, 2013
Cultural drivers	Approaching the circular economy and the utilization of more resources and capabilities are positively associated with workers' employment in green jobs.	Bytyqi et al., 2023
Economic drivers Entrepreneurial drivers	The crucial role of implementing circular economy practices in small and medium enterprises (SMEs) among EU member States can better build up green skills, in alignment with resource efficiency, green markets, and circular economy procedures. Extra environmental skills can be perceived to sustain a positive effect on the intention to implement actions in the future. Older and bigger firms, having larger yearly turnover, are more able to undertake and implement actions	Bassi & Guidolin, 2021
Economic drivers Entrepreneurial drivers	Green jobs are characterized as one of the two main moderators for cost-efficiency advantage to emerge among European SMEs, namely, eco-innovativeness (investments directed to adequate implementation of circular practices of production processes) and green jobs (human resources directed to circular practices). European SMEs can be fostered by the implementation of increasingly more circular economy-based practices. Among the other benefits of such a circularity adoption logic in European SME operations is the reduction in their production costs. Sharing of green jobs in SMEs' workforce can further contribute to the United Nations goals for Sustainable Development.	Darmandieu et al., 2022
Economic drivers Entrepreneurial drivers	The circular economy proposal enables a more sustainable and durable economy model. Subsequently, relevant pro-environmental economic models induce radical changes in the labor market in which green jobs are operating. Green jobs are most noticeable within the environmental goods and services sector (EGSS), especially among 28 European Union countries in the last 2 decades of analysis. Sustainable Development Goals (SDGs) can support CE by enhancing the green jobs positions while combining factors that influence green jobs and the creation of EGSS under the perspectives of the circular economy.	Sulich & Sołoducho-Pelc, 2022
Governance and organizational drivers	Contribution of green jobs to sustainable growth in the field of economy and the adopted economic policies adopted around the world. Green jobs are directly or indirectly connected to the activities of eco-friendly companies.	Bernat, 2012.

Table 2

Drivers of Transformative Change Towards Carbon Neutrality (Continued)

Types of drivers	The main drivers	References
Governance and organizational drivers	Green jobs are related to the energy sector and in particular to the implementation of the SDGs, being especially fitting to SDGs 7 and 8	Kozar & Sulich, 2023
Governance and organizational drivers	Green jobs' creation is linked to the ways in which the network structures' costs can influence collaboration effectiveness to achieve their desired outcomes. Such types of collaboration can also determined by threshold effects of collaboration costs on participants.	Kwak & Feiock, 2023
Governance and organizational drivers	Green jobs' creation is linked to the ways in which the network structures' costs can influence collaboration effectiveness to achieve their desired outcomes. Such types of collaboration can also determined by threshold effects of collaboration costs on participants.	Kwak & Feiock, 2023
Governance and organizational drivers	Feasible and realistic opportunities for green job training and employment are revealed. Besides, intellectual stimulation and an increased accomplishment sense are achieved, mainly because of the uniqueness of environmental work. Well-trained green-collar labor force can increase as many cities involve the implementation of sustainability and green infrastructure plans.	Falxa-Raymond et al., 2013
Governance and organizational drivers	Social justice and environmental preservation are the main concerns of scholars and practitioners, enabling them to embrace a definition of green jobs that is bottom-up or people-centered. Non-governmental organizations can immensely support transformative, locally sustainable green employment and livelihoods through pilot-demonstrated projects, fostering innovation, conducting research, forming coalitions, and engaging in advocacy when local institutions and market conditions. Thereafter, consumers and providers can risk averse to off-grid renewable energy adoption.	Acey & Culhane, 2013
Technological and technical drivers	The surveying profession is a type of green profession that uses in-field information, tools, and techniques to achieve key objectives of sustainable development. Property investment and finance of commercial property are advantageous in green jobs, compared to other faculties' positions in an international context.	McNamara et al., 2008
Technological and technical drivers	Firms involved in the circular economy have a higher probability of generating green jobs, under the principles of reusing, redesigning, and reducing practices. The separate consideration of different actions of circular economy, energy efficiency, and waste minimization, each one showed a positive relationship with numerous green jobs, whereas recycling practices are not relevant. The probability of supporting green employment and a wide range of green jobs is directly related to materials reuse and redesign. Larger firms are more likely to offer green jobs compared to smaller-sized companies. Technological capabilities, openness to external sources of knowledge, and specialties of green products and services can play a decisive role in the development of a greater number of green jobs	Moreno-Mondéjar et al., 2021

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Table 2
Drivers of Transformative Change Towards Carbon Neutrality (Continued)

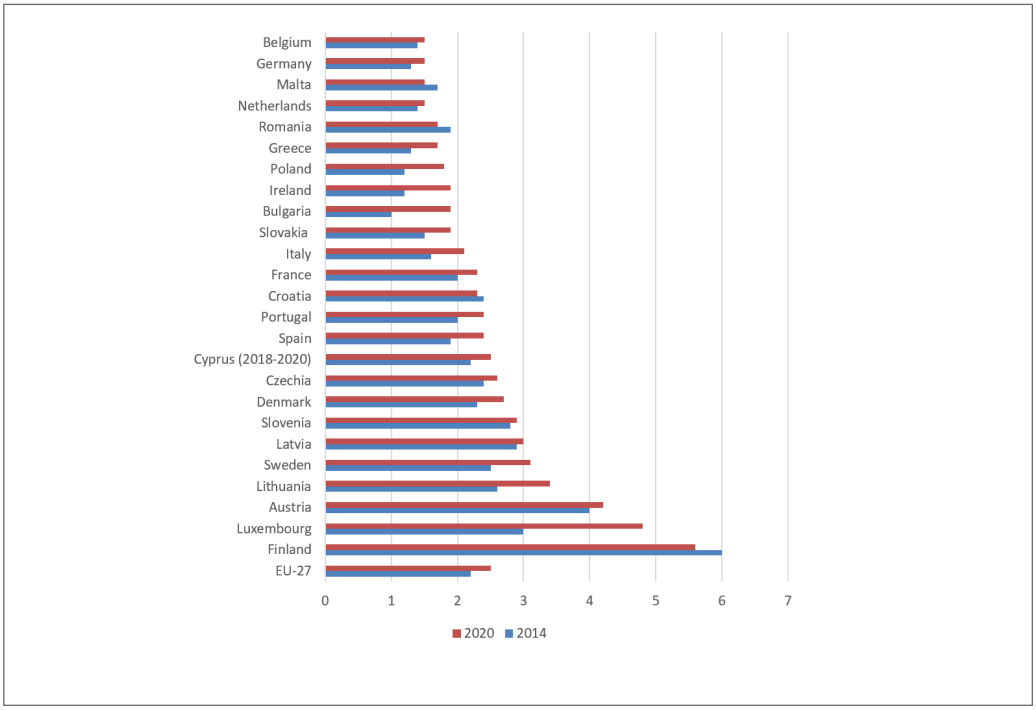
Types of drivers	The main drivers	References
Technological and technical drivers	Recently, the renewable energy sector has shown rapid expansion, since the employment in renewables-driven and supplier-related industries is conservatively estimated at 2.3 million worldwide. Cooperative technology development and technology-sharing programs expedite processes and replicate best practices. One billion people are engaged in forestry management, often through non-timber forest products. The greener side of construction jobs can ensure that new buildings meet high-performance standards. Besides, existing buildings retrofits make them more energy-efficient, and have high job potential for construction-related jobs: workers, architects, energy auditors, and engineers. Typical society sectors that boost the green jobs are that of the transportation industry, green auto manufacturing jobs, modern rail, and urban transit systems, as well as good jobs are being generated by the emergence of bus rapid transit systems, offering green employment opportunities in retrofitting old diesel buses to reduce air pollutants and operating cleaner compressed natural gas (CNG) together with hybrid-electric buses.	Renner et al., 2008
Social and behavioral drivers	Driving factors of green jobs development can be considered the stakeholders' cooperation at an industry-research interaction.	Battaglia et al., 2018
Social and behavioral drivers	Green jobs can be considered as key collective social action to concretely support sustainable development, as a long-term endeavor. Microeconomic and macroeconomic sectors and factors play a decisive role in the future growth of green jobs. Green products and service innovation are primarily relevant to the green job creation. Environmental management systems and products and service innovations' interplay should sustain an important and positive affection to the hiring decision in green jobs.	Cecere & Mazzanti, 2017
Social and behavioral drivers	Societal industrialization needs are met by the development of a social workplace. While limited literature is devoted to social work and the environment, the social work profession has not fully embraced the need to coupling environment-centered issues into social work education or practice.	Shaw, 2013

member states, excluding Finland and Romania. In Finland, the share of total employment in green employment declined by 3%, and in Romania, green employment was reduced by 15% during this period. The largest growth in green employment can be observed in three countries, that is, Bulgaria (98%), Luxembourg (87%) and Ireland (79%).

It is necessary to highlight that domains of green employment differ between EU MS. In Estonia, for example, employment in the management of energy and water resources was responsible for more than 50% of total environmental employment in the country in 2020. A similar situation can be observed in Finland, Luxembourg, and Sweden in the same year. However, in other MS, like Belgium and Croatia, employment in waste and wastewater management activities accounted for 78% of environmental employment. A similar situation was observed in Malta, where employment in this sector made up 73% of all green employment. Nevertheless, the shares of green employment in total employment of the country were highest in Estonia and Finland, where green employment accounted for more than 5% of all countries' employment in 2020. Though

Figure 1

Employment in the Environmental Goods and Service Sector in EU Member States in 2014 and 2020, %



Source: (European Environment Agency, 2024)

the share in Finland has decreased since 2014, the numbers in 2020 are still higher than those of other MS. Moreover, In Luxemburg, green employment was very close to 5% in 2020 as well. The Netherlands, Malta, Germany, and Belgium had the lowest shares (below 1.5%) of green employment in total employment in 2020.

The EUROSTAT collects data for EU MS on persons employed in circular economy sectors, measured as a percentage of total employment in full-time equivalent (FTE). This indicator measures the share of persons employed in the recycling, repair, reuse, rental, and leasing sectors compared to the total employed persons in the country. In Table 3, the development of employment in circular economy sectors is given for EU member states.

The numbers of employment in the circular economy sector can also be treated as green jobs as they show employment in recycling, repair and reuse, rental, and leasing sectors, which are sectors providing pollution reduction and resource-saving services. The leading countries in the share of employment in circular economy are Croatia, Poland, Hungary, Lithuania, and Latvia. Austria, Netherlands, and Romania are among the worst-performing countries according to this indicator

European Commission initiated the 2021 monitoring of renewable energy of each EU MS based on provisions of the Renewable Energy Directive 2018/2001 or RED II directive. The number of jobs available in the renewable energy sector is provided for 2020 and 2021 by the EU Observer (EC, 2022).

The renewable energy jobs in EU member states in 2020 and 2021 are provided in Figure 2.

Based on EC (2022) data, about 1.5 million persons are working in the EU's renewable energy sector, including direct and indirect jobs linked to the renewable energy sector. From 2020 to 2021 the

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Table 3

Employment in Circular Economy Sectors, of EU Member States, Percentage of Total Employment - Numerator in Full-time Equivalent (FTE)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
EU-27	2.0	2.0	2.1	2.1	2.1	2.1	2.2	2.1	2.2	2.2
Belgium	1.4	1.4	1.3	1.4	1.3	1.3	1.3	1.3	1.3	1.3
Bulgaria	1.5	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5
Czechia	2.4	2.3	2.2	2.3	2.3	2.3	2.2	2.3	2.3	2.3
Denmark	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Germany	1.5	1.4	1.5	1.5	1.6	1.6	1.7	1.6	1.7	1.7
Estonia	1.8	1.9	2	2	1.9	1.9	2.1	2.0	2.2	2.2
Ireland	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.4
Greece	1.4	1.3	1.5	1.3	1.5	1.4	1.5	1.5	1.3	1.3
Spain	1.9	2	2	2.1	2.1	2.1	2.2	2.2	2.3	2.3
France	1.8	1.8	1.8	1.7	1.7	1.9	1.8	1.8	1.8	1.8
Croatia	2.7	2.8	2.9	2.9	2.8	2.9	3.1	3.5	3	3.1
Italy	2.3	2.4	2.4	2.5	2.5	2.4	2.3	2.5	2.5	2.4
Cyprus	1.4	1.5	1.5	1.7	1.8	1.8	1.9	1.9	1.9	2.0
Latvia	2.4	2.4	2.6	2.6	2.7	2.6	2.5	2.4	2.7	2.8
Lithuania	2.4	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.8	2.8
Luxem-bourg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4
Hungary	2.8	2.5	2.2	2.4	2.5	2.5	2.6	2.3	2.3	2.3
Malta	2.5	2.4	2.3	2.2	2.3	2.1	2.1	2.0	1.9	1.9
Nether-lands	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Austria	1.1	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Poland	2.5	2.6	2.5	2.6	2.6	2.6	2.6	2.7	2.7	2.7
Portugal	1.8	1.8	1.8	1.8	1.8	1.9	2	1.8	1.8	1.8
Romania	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2
Slovenia	1.6	1.6	1.6	1.6	1.6	1.6	1.7	2.0	1.5	1.5
Slovakia	2.0	2.0	1.9	2.0	2.0	2.0	2.0	2.0	2.1	2.2
Finland	1.7	1.7	1.7	1.7	1.6	2	2.3	1.8	1.6	1.5
Sweden	1.6	1.6	1.6	1.6	1.7	1.7	1.6	1.6	1.7	1.7

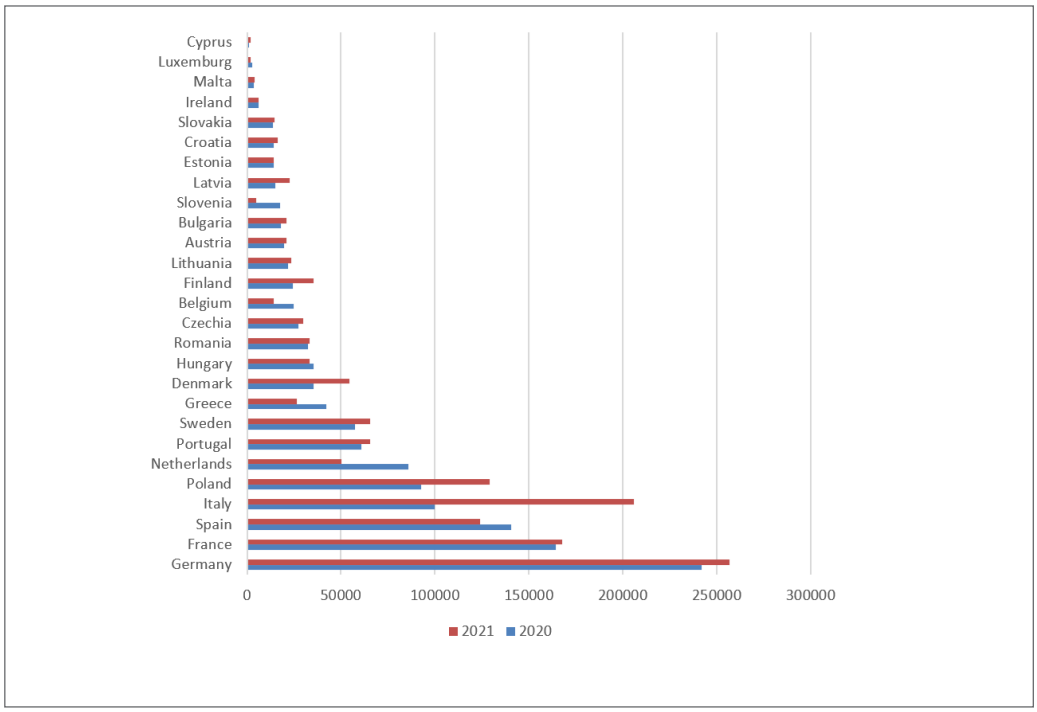
Source: EC (2024)

number of green jobs number has increased by 12%, creating 156 700 jobs. In 18 EU Member States, green energy jobs increased or remained stable during 2020-2021. There are 5 countries that have the largest number of jobs in the renewable energy sector of the EU. Germany in 2021 has 256 800 job places in the renewable energy sector or 17% of all EU renewable employment), Italy (206100 jobs or 14% of all EU renewable jobs), France (167 800 jobs or 11 % of total renewable jobs in EU. Poland had 129 300 jobs or 9% of overall EU renewable jobs, followed by Spain with 124 000 renewable jobs or 8% of the EU total jobs in the renewable energy sector.

From 2021, the highest growth in green jobs will be noticed in Italy. Also, a large increase can be noticed in Poland as 36 new 700 renewable energy jobs were created, providing a 40% increase from 2020. In Denmark, -19000 new renewable energy jobs emerged in 2021, showing a 54% increase since 2020. In Austria, 10,500 new green jobs were cre-

Figure 2

Employment in the Renewable Sector of EU Member States



Source: EC (2022)

ated, providing for 53% growth in renewable energy employment. The greatest decreases can be noticed in Spain as the country lost 16500 renewable energy jobs or employment in the renewable energy sector declined by 12% during the same period. In Greece, a decrease of 15700 jobs or 37% decrease was noticed, and in Slovenia, a decrease of 12500 jobs or a decrease in renewable energy employment by 71% can be observed during the 2020-2021 period.

Heat pumps create the biggest employment in the renewable energy sector, followed by solid biomass and solar PV. The highest increase in renewable energy employment during an analyzed period can be noticed in the solid biomass sector, where 70 800 new jobs were created, providing for 25% growth of employment in this sector, followed by heat pumps and solar PV, providing for the creation of 58500 and 57400 new jobs, respectively. The increase in employment in the renewable energy sector was observed in the biofuels, hydropower, and geothermal sectors during the 2020-2021 period, and a decline was noticed in sectors lined with biogas and wind technologies.

7. Conclusions

Green jobs provide many benefits as they are safe and hazard-free, remunerative, and. Secured. Green jobs benefit the whole society as they reduce the consumption of energy and materials, reduce waste and water, air, and noise pollution, mitigate climate change, and safeguard the ecosystems.

Green jobs are growing steadily in the EU due to the implementation of green growth policies and targets set by the EU Green Deal. Though there is huge potential for new green employment due to the fast development of the circular economy and fast penetration of renewable energy sources, there are still many barriers hampering the growth

of green employment. The main barriers to green job expansion are cultural, economic, entrepreneurial, governance and organizational, social and behavioral barriers, health-occupational barriers, etc. Lack of capital, skills, and information are the main barriers to green employment.

Policies and measures are necessary to overcome these barriers and unlock green economy potential in EU member states. These policies can be treated as economic, governance and organizational, information dissemination, social and behavioral, technological, and technical drivers of green jobs.

The main economic policies to promote green jobs are the advancement of direct investment into green projects and infrastructure, the introduction of hiring subsidies for companies to incentivize the creation of green jobs, the establishment of tax credits for green jobs establishment in remote and rural areas, provision of financial support to employees to incentivize green upskilling, training, education and preparation for green jobs.

The main governance and organizational policies include the introduction of a green employer ranking framework to designate the topmost green job employers, the development of localized green skills plans, the establishment of green apprenticeship systems to upskill and channel employees into green jobs

The main information dissemination policies are: highlighting the green skills and jobs through job centers, using communications campaigns to inspire employees to have training or education, and introducing a system for green jobs and skills to spread information to important stakeholders about the green transition processes and their outcomes, the introduction of green job badges/certifications and by improving their searchability, implementation of job referral programs promoting green jobs application, running information campaigns about the benefits of green jobs for society and employees.

Technological and technical policies for promoting green jobs are linked with developing skills necessary for green jobs. They include the promotion of STEM subjects and integration of them in secondary and tertiary education, including the essential green skills in educational curricula, the creation of a network of various centers of excellence for green job skills, increasing involvement in training among workers by changing default options, and improving accessibility of green jobs in terms of logistics, designing the matchmaking facilities for connection of workers to green jobs and green skills training based on their experience and capacities, encouraging employers to publicize green jobs, etc.

There are several indicators for green jobs monitoring in the EU. Though in absolute numbers, the leading countries according to available green jobs are Germany, France, Italy, Poland, and other biggest countries. The shares of green employment in total employment are the highest in Estonia and Finland, creating more than 5% of all jobs. In Luxemburg, -almost 5% of all jobs in 2020. At the same time, the lowest shares, of less than 1.5%, were reported for the Netherlands, Malta, Germany, and Belgium.

The differences between EU MS in green jobs statistics imply different requirements for the implementation of policies and measures to promote green jobs and overcome barriers to unlocking the full potential of green jobs in the EU. A deeper analysis of green jobs barriers and policies necessary to overcome these barriers are necessary at the EU member states levels. Future research must investigate the main differences between EU MS in green jobs expansion and proposed new policies based on good practices.

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