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# Green Jobs: Driving Economic Growth and Sustainability in the Global Energy Transition

Esposito Luca<sup>1</sup>, Romagnoli Giulia<sup>2</sup>, Tricarico Luca<sup>3</sup> and Xihui Chen<sup>4</sup>

<sup>1</sup> University of Salerno, Department of Economics and Statistics and University of Eastern Finland, Karelian Institute - [luca.esposito@uef.fi](mailto:luca.esposito@uef.fi); [lucaesposito1@unisa.it](mailto:lucaesposito1@unisa.it) [Corresponding author]

<sup>2</sup> University of Cassino and Southern Lazio - [giulia.romagnoli@unicas.it](mailto:giulia.romagnoli@unicas.it)

<sup>3</sup> Researcher at CNR (National Research Council), Institute on Sustainable Economic Growth - [luca.tricarico@ircres.cnr.it](mailto:luca.tricarico@ircres.cnr.it)

<sup>4</sup> School of Management, Zhejiang University of Technology, Hangzhou China - [jerrychen0526@foxmail.com](mailto:jerrychen0526@foxmail.com)

**Sintesi** Questo studio esamina il ruolo fondamentale dei green jobs nell'economia verde e nella transizione energetica. Le nostre conclusioni sottolineano che una gestione strategica della creazione di green jobs può apportare un notevole contributo alla crescita economica, sia nei paesi sviluppati che in quelli in via di sviluppo. In particolare, l'analisi rivela consistenti investimenti da parte di aziende italiane e internazionali nel settore dell'economia verde e della sostenibilità, in sintonia con gli sforzi globali per affrontare sfide come il cambiamento climatico e promuovere la transizione verso una società sostenibile.

**Abstract** This study investigates the crucial role of green jobs in the green economy and energy transition. Our findings emphasize that strategically managing the creation of green jobs can significantly contribute to economic growth in both developed and developing nations. Notably, our analysis reveals substantial investments by Italian and international companies in the green economy and sustainability, aligning with global efforts to address challenges like climate change and foster the development of a sustainable society.

**Keywords:** Green Jobs; Green Economy; Energy Transition; Sustainable Investments.

**JEL codes:** J01, Q42, Q56, Q58

## 1. Introduction

Concern for the environment and the imperative to address climate change have intensified globally, prompting a shift towards a sustainable economy. The transition to a distributed energy system based on renewable resources not only promotes environmental sustainability but also creates significant opportunities for the development of green jobs. These jobs, ranging from managing renewable energy projects to maintaining renewable infrastructure, foster social and technological innovation, transforming the way energy services are produced and managed. This approach not only stimulates local cooperation and capacity building but also contributes to rethinking urban and regional planning practices, promoting more inclusive and sustainable development (Tricarico, 2018). In Europe, the convergence of the green economy and renewable energy is fostering innovative and sustainable job prospects, reshaping the labor market, and catalyzing rural and energy community development (Houssam et al., 2023). The rapid expansion of the renewable energy sector, driven by governmental incentives, advancing technologies, and heightened environmental consciousness, demands specialized skills across the design, development, installation, and maintenance stages. This sector expands employment prospects, encompassing engineering, architecture, environmental

science, and maintenance. Notably, green jobs offer enhanced stability and security compared to traditional industries, often rooted locally due to their specific knowledge requirements and environmental interactions. Therefore, they contribute to localized job creation and sustainable community growth (Tănăsie et al., 2022).

The transformative impact on the labor market, driven by the green economy and renewable energy adoption, is the focus of this project.

This paper contributes by offering a comprehensive analysis of the current European labor market scenario in the context of the green economy and renewable energy adoption. It aims to assess opportunities, provide critical commentary on results, and offer political implications. The specific contribution lies in its focus on the transformative impact of the green economy and renewable energy adoption on the labor market, particularly within the European context.

Compared to existing literature, this paper adds value by providing an in-depth analysis of the convergence of the green economy and renewable energy sectors in Europe, with a focus on their impact on job creation, labor market dynamics, and community development. It synthesizes existing research findings and offers insights into the potential economic and social repercussions of the transition towards green growth and the circular economy. Additionally, the paper highlights the significance of localized job creation, sustainable community growth, and the need for policies that balance economic development with environmental preservation.

Furthermore, the paper addresses the complexities of green job definitions and their implications for various sectors, shedding light on emerging employment opportunities in renewable energy, sustainable agriculture, urban infrastructure, and other green industries. By examining global trends and regional disparities in green job opportunities, the paper provides a nuanced understanding of the labor market dynamics within the context of the green economy.

Overall, the paper contributes to the existing literature by offering a comprehensive analysis of the impact of the green economy and renewable energy adoption on labor markets, particularly in Europe. It synthesizes empirical evidence, identifies key trends, and provides valuable insights for policymakers, researchers, and practitioners seeking to navigate the transition towards a more sustainable and equitable future.

## **2. Impact of the Green Economy on Labor Markets**

The last decade has experienced a transition from linear to circular economy models (Michellini et al., 2017). This transition can be interpreted as a change of course aimed at preventing the depletion of resources (Barriero-Ge et al., 2020) and considering the natural environment as a heritage to be preserved and protected. From an economic point of view, it is seen as a set of resources to be used wisely, to guarantee conditions of lasting balance over time and avoid irreversible transformations. From this perspective, the transition process towards green growth and the circular economy will generate 18 million new jobs by 2040 (Chateau et al., 2020), with important economic and social repercussions (Vona et al., 2018). The benefits arising from these professional roles vary significantly, as they contribute advantages to both traditional and emerging sectors (Esposito et al., 2014), fostering the spread of specialized personnel. It is necessary to balance and allow work in harmony with today's society which aims to reduce unemployment and environmental degradation (Sulich et al., 2020). The aim is to create decent jobs, capable of generating a fair income, providing job security, and ensuring social protection for families. Many scholars (Sulich et al., 2022) have concluded that both the green economy and clean technology have a positive effect on employment, especially in the context of renewable energy and the agricultural sector. The existing scientific

literature shows that production through renewable energy sources is the engine of employment (Engel et al., 2009), but in some cases, it could also promote unemployment, due to the restructuring of industrial paradigms (Grenn, 2011). Despite this, the green economy, and renewable energy in particular, have contributed positively to employment, creating decent jobs, and representing an important potential for economic growth (Chan et al., 2012). Moreover, employment growth is highest in green industries and decreasing in the fossil fuel industry. This trend reflects the shift towards more sustainable energy sources and the progressive abandonment of the most polluting resources. In addition, it has been estimated that expanding investment in clean energy can generate a net increase of about 1.7 million jobs (Pollin, et al., 2009) and that the renewable energy sector generates more jobs per unit of energy than the fossil fuel sector (Engel et al., 2009). Another interesting aspect is the political scenario EU policies on renewable energy are among the most progressive in the world, confirming that even at the European level, the renewable energy sector is considered of fundamental importance in terms of employment and added value creation (Ragwitz et al., 2009). The transition towards increased sustainability has engendered the emergence of a new economic paradigm, commonly referred to as the green economy. This paradigm places emphasis on ecological transition and the cultivation of sustainable, environmentally friendly economic activities (Tánaiste, A.V. et al., 2022).

The green economy and the need for an ecological transition in the European Union have become drivers of economic growth in many countries with a significant impact on labor markets. The figure for renewable energy jobs worldwide from 2012 to 2021 (Figure 1) shows an extraordinary growth and transformation trend in the energy industry. In the past nine years, the number of jobs in the renewable energy sector has grown exponentially, resulting in significant economic and social impacts.

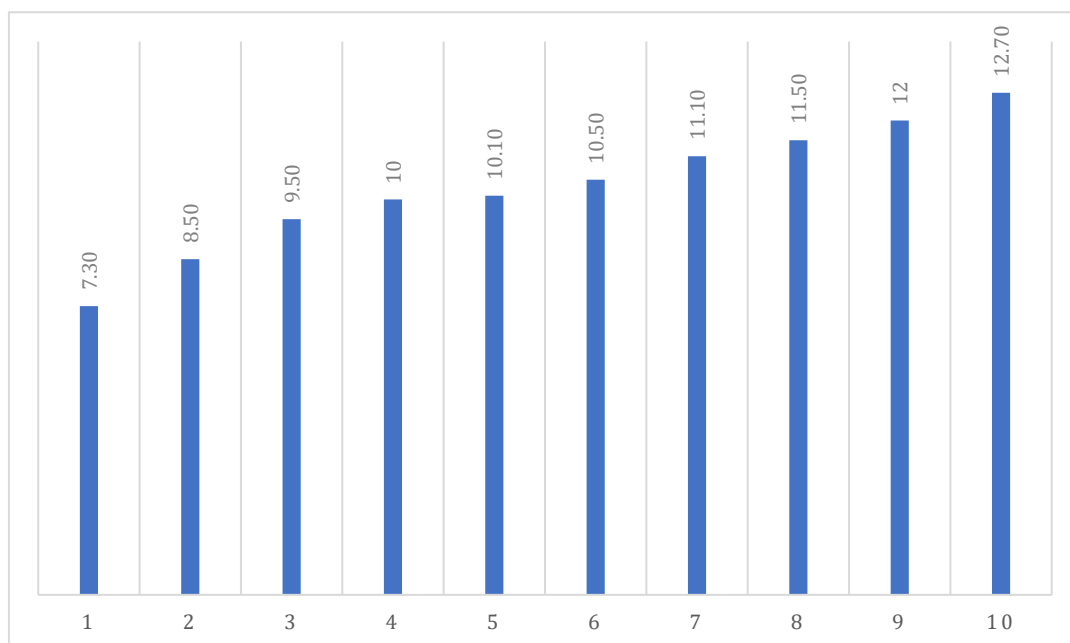


Figure 1: Global renewable energy sector jobs 2012-2021. Source: IRENA.<sup>1</sup>

<sup>1</sup> IRENA. (September 27, 2023). Number of renewable energy jobs worldwide from 2012 to 2022 (in millions) [Graph]. In *Statista*. Retrieved June 10, 2024, from <https://www.statista.com/statistics/859908/employment-in-renewable-energy-sector-globally/>.

This structural change in the labor market is leading to a reallocation of jobs as well as the promotion of more so-called "green jobs" (European Commission, 2022).

### Definition of Green Jobs

The definition of green jobs is crucial within the context of transitioning towards a sustainable economy. Despite considerable efforts, achieving unanimity on the precise definition of a "green job" remains elusive (Stanef-Puică, et al., 2022). However, various interpretations converge around essential characteristics. According to Unioncamere definition they are those jobs that aim to safeguard the Earth and its well-being, seeking to support human development without negatively impacting the surrounding environment (Unioncamere, 2022). This broad definition reflects the intricate nature of activities deemed "green". While some definitions narrow their focus to specific sectors like renewable energies or waste management, others encompass a broader array of professions, including environmental design, sustainable mobility, agriculture, and research and development in clean technologies.

Moreover, the definition of green jobs varies based on geographical, political, and economic contexts, necessitating tailored policies and strategies to foster green employment according to the unique priorities and challenges of each region or nation. Furthermore, it is crucial to acknowledge that green jobs typically entail occupations that not only provide equitable working conditions but also actively contribute to environmental conservation or restoration (UNEP, 2008). This understanding underscores the significance of initiatives such as the Green Jobs Act and the American Recovery and Reinvestment Act of 2009, which have propelled the concepts of the "green economy" and "green jobs" into the forefront of legislative discourse (Carnevale A. P., 2013).

These complexities highlight the ongoing debate and ambiguity surrounding the green economy and green jobs. Nevertheless, it can be assumed that green jobs are typically related to occupations that provide decent working conditions and contribute to the preservation or restoration of the environment (UNEP, 2008).

Figure 2 analyzes the job opportunities for sustainable recovery between 2020 and 2030 and highlights the four most promising sectors: restructuring the textile and clothing value chains, expanding green urban transport, implementing natural urban infrastructure, and developing climate-smart agriculture. The textile and clothing sector opens the way to new employment possibilities through the rethinking of supply chains. The expansion of green urban transport represents another important source of employment opportunity, with the introduction of new environmentally friendly transport services, innovative infrastructure, and high-energy technologies. The creation of natural urban infrastructure offers new prospects for better integration of green spaces in cities, and the development of climate-smart agriculture with sustainable farming practices will create new employment opportunities in the agri-food sector. Considering the employment opportunities by macro-regions, the analysis shows that the regions of East Asia and the Pacific, South Asia, and Latin America have the highest percentage of employment opportunities (Figure 3). These regions demonstrate a significant commitment to promoting policies and investments aimed at transitioning to a greener and more sustainable economy. Through these policies and investments, they have created a favorable environment for employment growth in the clean energy sector and environmentally friendly agricultural practices.

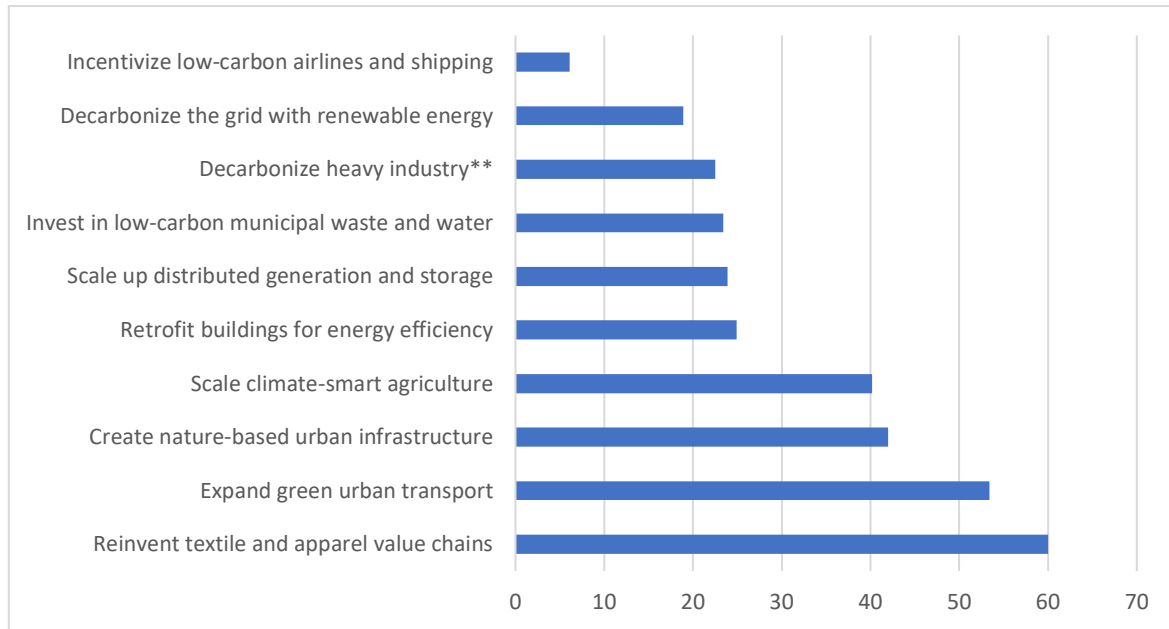


Figure 2 Green employment opportunities in emerging markets\* across key sectors between 2020 and 2030 (in millions)<sup>2</sup>

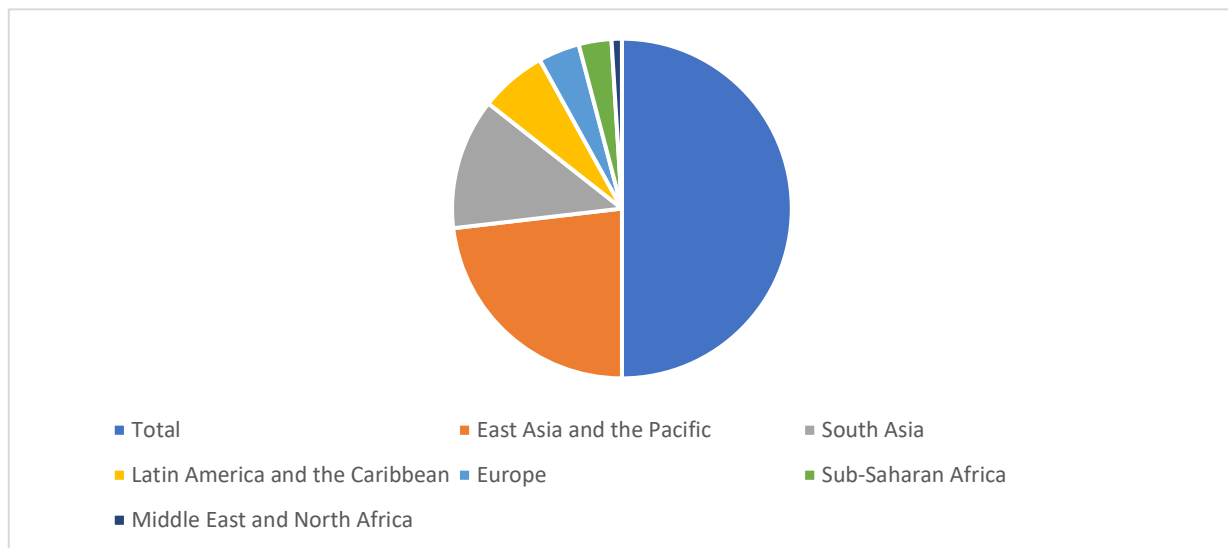


Figure 3 Green employment opportunities in emerging markets\* across key sectors between 2020 and 2030, by region (in millions)<sup>3</sup>

They involve the production, installation, maintenance, and management, as well as research and development, of technologies and infrastructures related to renewable energies and sustainability. These jobs often promote the protection of ecosystems and biodiversity, reduce energy, materials,

<sup>2</sup> International Finance Corporation. (January 14, 2021). Green employment opportunities in emerging markets\* across key sectors between 2020 and 2030 (in millions) [Graph]. In *Statista*. Retrieved June 10, 2024, from: <https://www.statista.com/statistics/1258751/new-direct-jobs-by-sector/>.

<sup>3</sup> International Finance Corporation. (January 14, 2021). Green employment opportunities in emerging markets\* across key sectors between 2020 and 2030, by region (in millions) [Graph]. In *Statista*. Retrieved June 10, 2024, from: <https://www.statista.com/statistics/1257893/new-direct-jobs-by-region/>.

and water consumption through high-efficiency strategies, facilitate the decarbonization of the economy, and minimize or completely avoid waste generation and pollution (UNEP, 2008).

### Green Jobs Opportunities

The widespread adoption of renewable energies and the advancement of the green economy have spurred substantial demand for green jobs on a global scale (European Commission, 2022). Analyses examining the influence of the green economy on the labor market and its implications for new job creation have produced noteworthy findings. Projections for 2030 suggest that the renewable energy sector alone will generate over 40 million jobs globally (IRENA and ILO, 2022), with Europe accounting for 18 million of these positions (ILO, 2018).

Since green jobs are expected to grow (Dell'Anna, F., 2021), many countries have recognized the importance of investing in these new industries to stimulate economic growth, reduce greenhouse gas emissions, and create sustainable jobs. According to the literature, investing in and promoting the use of renewable and low-carbon energy sources has the potential to generate direct and indirect strong positive effects on the economy (Wei, M., 2010) and more jobs per unit of energy produced compared to the fossil fuel sector as well (IRENA and ILO, 2022).

### Solar Energy Sector

The solar industry is one of the key sectors where green jobs are thriving. The installation of solar panels on rooftops, land, and industrial plants is becoming increasingly common. This has led to the need for specialized technicians in solar installation, solar electrical and thermal engineers, solar system designers, and many other professionals. Additionally, the production of solar panels requires a skilled workforce for the manufacturing of photovoltaic cells and managing the production processes. According to the IRENA Renewable Energy and Jobs Annual Review 2022, in 2020, the photovoltaic (PV) industry employed approximately 4 million individuals in Europe, with around 235,000 jobs located in the EU Member States. This demonstrates the substantial workforce engaged in solar technologies within the region. Comparatively, the United States experienced a recovery in PV employment, reaching 255,000 workers after a decline in 2020. China, renowned as the global leader in PV equipment production and the largest installation market, accounted for approximately 63% of worldwide PV employment, employing around 2.5 million individuals. Meanwhile, India's solar industry provided an estimated 217,000 jobs, with 137,000 in on-grid settings and an additional 80,600 in off-grid environments (Global Wind Report, 2023).

### Wind Energy Sector

Similarly, wind energy is experiencing significant growth and is expected to create tens of millions of new job opportunities (IRENA and ILO, 2021). Onshore and offshore wind farms are becoming more prevalent. This has created a demand for engineers and technicians specialized in the design, installation, and maintenance of wind turbines. Additionally, the management of wind power networks requires experts in monitoring and optimizing turbine performance. According to recent data, employment in the wind sector globally increased to 1.4 million jobs in 2021, up from 1.25 million in 2020. China alone accounted for 48% of global wind employment, with Asia representing 57%, Europe 25%, the Americas 16%, and Africa and Oceania 2%. Moreover, activities in wind power projects from 2022 to 2026 are projected to generate approximately 230,000 full-time equivalent job years in India, 115,000 in Brazil, 59,000 in the Philippines, 37,000 in South Africa, and 29,000 in Mexico. These job opportunities are expected to have direct and indirect impacts on employment, contributing to the local economies of these countries (IRENA and ILO, 2021) (Araújo, N. et al., 2018).

### Hydropower and Biomass Energy Sector

The hydropower sector, which harnesses energy from flowing water, also offers numerous green job opportunities. The construction and operation of dams, hydropower plants, and tidal power stations require a variety of skills, including civil, electrical, and environmental engineers. Furthermore, energy derived from biomass, such as biogas and biodiesel, is gaining popularity as a sustainable alternative to fossil fuels, generating additional job opportunities. According to recent data, approximately 2.2 million people were directly employed in the hydropower sector (IRENA and ILO, 2021), increasing to approximately 2.36 million people in 2021. Globally, two-thirds of these jobs were in manufacturing, 30% were related to construction and installation activities and about 6% were in operation and maintenance services (Global Wind Report, 2023).

### Other Sectors

Green economy also promotes energy efficiency and sustainability in other sectors (StaneŃ-Puică, M.R. et al., 2022). For example, the construction industry is adopting sustainable building practices, creating a demand for eco-friendly building designers, energy consultants, and experts in sustainable construction materials (UNEP, 2008) (Araújo, N. et al., 2018). Similarly, the transportation sector is witnessing the emergence of electric vehicles and the adoption of low-emission public transport systems, which require technicians specialized in the maintenance and management of these new technologies, particularly in Europe, the Americas, and Asia (UNEP, 2008) (ILO, 2020). The green economy also offers job opportunities in waste management and recycling (Vesere, R. et al., 2021). The adoption of more sustainable waste disposal policies and the promotion of recycling has created a demand for operators of recycling facilities, environmental consultants, and engineers for the development of advanced recycling technologies.

Renewable energies and the green economy play a crucial role in driving the growth of green jobs in global labor markets. This transition towards a more sustainable economy offers significant employment opportunities and contributes to the fight against climate change and environmental pollution. However, targeted investments, smart government policies, and global commitment to sustainability are essential to fully harnessing the potential of renewable energies and creating better prospects for future generations (Stilwell, F., 2021).

### 3. Projections for Green Jobs

The prospects for green jobs are extremely promising due to the increasing adoption of renewable energies and the continued growth of the green economy (ILO, 2013). According to the European Centre for the Development of Vocational Training, between 2020 and 2030, employment in the EU is projected to experience a growth of approximately 3.7% (Cedefop, 2021). This value is expected to increasingly grow with the introduction of supportive policies within the European Green Deal scenario. Regarding green jobs, the statistics for 2030 indicate that the renewable energy sector will generate more than 40 million jobs worldwide (IRENA and ILO, 2022), with 18 million of those in Europe (ILO, 2018). The energy transition and the presence of renewable energy communities have played a key role in terms of the growth of green jobs. Denmark, for example, on the island of Samsø, produces 100% renewable energy, and this has generated a chain of new job profiles, specialised in sustainability, circular economy and energy transition. A further example comes from Freiburg, a city of 220,000 inhabitants that has generated, thanks to the presence of 'green districts', around 13,000 jobs in the green economy sector. In this context, it should be specified that the spread of green jobs, proceeds at different speeds at European level, depending on various factors, related to

the market, production and national energy policy choices. For example, China, which is among the largest producers and installers of solar energy, generated around 3.8 million jobs in 2017 alone, and the numbers are constantly growing (IRENA, 2018). Further interesting figures are recorded in Japan, with about 272,000 jobs in 2017, and in the United States, in fact, from 2017 to 2024, a growth of 108% has been estimated.

However, one of the primary drivers behind the surge in green jobs is the pressing need to address climate change, prompting governments worldwide to commit to the objectives outlined in the Paris Agreement, which entails swiftly transitioning to clean energy sources and nurturing a robust green economy (Sulich, A. et al., 2020).

Furthermore, the decarbonization of other key sectors of the economy, such as transportation, industry, and construction, will further contribute to the proliferation of green jobs (Araújo, N. et al., 2018) (ILO, 2020) (Vesere, R. et al., 2021). The adoption of electric vehicles, energy efficiency in buildings, and the promotion of sustainable production processes will require a skilled workforce for the design, installation, and maintenance of these new technologies. This will create a huge demand for green jobs in related sectors (ILO, 2020).

The transition towards a green economy will also promote technological innovation and open new markets. Companies focusing on the development of technologies and solutions for renewable energies will have the opportunity to grow and create highly skilled jobs. Start-ups dealing with solar energy, energy storage, smart grids, and sustainable mobility technologies will play a crucial role in stimulating innovation and the creation of green jobs (Pandiyan, P. et al., 2023). Certainly, this skill development and reallocation of workers entail the necessity of training resources to align with the change, imparting cross-functional competencies in the areas of innovation, sustainability, and digital transformation (Cedefop, 2021).

Another aspect to consider is the rise of government policies, incentives, and investments that promote the transition to renewable energies. Emission reduction targets, tax incentives, support programs, and regulations favoring clean energy sources will further facilitate the spread of green jobs. Moreover, increasing public awareness of the benefits of renewable energies and the growing demand for sustainable products and services will contribute to creating a favorable environment for the growth of green jobs.

Finally, meeting the demands of the renewable energy sector necessitates comprehensive workforce training and qualification efforts. Vital investments in education are imperative to equip workers with the evolving skill sets required in the green job market, as well as fostering equity and inclusion to guarantee that sustainable job opportunities are accessible to different communities.

#### **4. Conclusions**

This paper has examined the status and prospects of green jobs in the renewable energy and green economy sectors. The findings indicate a growing interest and commitment towards transitioning to a sustainable economy powered by renewable energy sources.

The evidence shows that the adoption of renewable energies is generating a significant increase in green jobs across various sectors, including solar, wind, hydropower, and geothermal energy. The growing awareness of climate change and the need to reduce greenhouse gas emissions have driven governments to promote policies that encourage investments in renewable energies and sustainability.

The outlook for green jobs is promising. Investments in the renewable energy sector continue to grow, and it is predicted to create millions of new jobs within the next decade. Moreover, the



increasing competitiveness of renewable energies compared to conventional energy sources will accelerate the transition towards a green economy and drive the demand for green jobs.

Despite notable advancements, persistent challenges demand focused attention. As previously highlighted, strategic investments in training and education remain crucial to empower workers with essential skills for green jobs. Additionally, the implementation of steadfast public policies and financial incentives is indispensable. These measures not only bolster the growth of the renewable energy sector but also incentivize businesses to adopt sustainable practices, thereby contributing to a more resilient and environmentally friendly economy.

International collaboration plays a pivotal role in the expansion and cultivation of green job opportunities. The cooperation among governments, industries, research institutions, and non-governmental organizations is indispensable for facilitating knowledge exchange, ensuring the effective implementation of policies, and expediting technological innovation in the domain of renewable energies.

### Policy Implications

This comprehensive analysis calls for a coordinated global effort to enhance the potential of green jobs. Policymakers should prioritize investments in education and training programs to ensure a skilled workforce capable of meeting the evolving demands of the green job market. Additionally, the development and implementation of stable and supportive public policies, coupled with targeted financial incentives, are imperative to sustain the momentum of the renewable energy sector.

International collaboration should be fostered through diplomatic efforts and multi-stakeholder partnerships. Policymakers must engage in knowledge-sharing initiatives and harmonize policies to create a conducive environment for the growth of green jobs. By addressing these policy implications, nations can collectively pave the way for a more sustainable, resilient, and environmentally conscious future.

### Limitations and future prospects

This study has some limitations, which need to be highlighted. Firstly, the study deals with the potential of green jobs in an "exploratory" way, outlining the current situation and possible future prospects, but it does not present any econometric estimates that would allow for an analysis of the elements that could influence the spread of green jobs or their impact on sustainable growth and energy transition.

In this perspective, an interesting aspect could be to analyse at a European level, the impacts that green jobs may generate in terms of employment and estimate through an econometric model, the variables that may predict or cause their greater diffusion.

This would also offer interesting insights and observations in terms of policy implications, indicating measures that if adopted could have an impact in the medium to long term.

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