

## Sustainability and Social Justice: The Relationship Between Renewable Energy, Job Creation, and Labor Rights in The Green Economy

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### Abstract:

**Background:** The transition to renewable energy sources is an essential foundation in the pursuit of a sustainable development model, directly impacting job creation and transforming the labor market. The green economy, by promoting the use of these energy sources, also raises concerns regarding labor rights and social justice, necessitating an assessment of working conditions in the sector and the effects of this transition on social inequalities.

**Materials and Methods:** This study adopted a qualitative approach, employing literature review and documentary research as the primary methods to examine the dynamics and processes related to the green economy. The literature review enabled a critical assessment of key works on the subject, while the documentary research focused on analyzing public policies and initiatives in the renewable energy sector.

**Results:** The main objective was to examine the interconnection between renewable energy development, job creation, and labor rights, assessing the consequences for sustainability and social equity. The findings demonstrated that allocating resources to renewable energy sources not only drives economic progress but also strengthens inclusive social policies, fostering improved living conditions for historically marginalized populations.

**Conclusion:** The study highlights that the transition to renewable energy contributes significantly to economic growth while promoting labor rights and social justice. The results underscore the need for comprehensive policies that integrate sustainability with equitable labor conditions, ensuring that the benefits of the green economy are distributed fairly.

**Keywords:** Sustainable Energy; Ecological Economy; Workers' Rights; Social Equity.

## **I. Introduction**

The search for a sustainable development model has become increasingly relevant in recent decades as society faces the challenges posed by climate change, environmental degradation, and social inequalities. Within this context, renewable energy sources emerge as a crucial option for fostering a sustainable economy, not only by reducing greenhouse gas emissions but also by generating new employment opportunities and transforming the labor market. Thus, the energy transition encompasses not only technical and environmental aspects but also social and labor dimensions, which require a thorough analysis to ensure that the benefits of the green economy are distributed equitably and fairly.

With the growing implementation of renewable energy sources, both challenges and opportunities arise in the realm of labor rights, necessitating adaptations and regulations to guarantee fair and decent working conditions for professionals in this sector. At the same time, the green economy presents an alternative development model that aims not only at environmental conservation but also at the promotion of social justice, contributing to the reduction of social inequalities and the construction of a more just society. Therefore, understanding the interconnection between renewable energy, job creation, and labor rights is crucial for assessing the impacts of this economic model on strengthening sustainability and social equity.

This study adopted a qualitative approach to investigate the dynamics and processes related to the addressed themes. Accordingly, literature review and documentary research methods were employed as essential tools for knowledge production in qualitative research. The literature review enabled a detailed analysis of current publications and debates regarding the energy transition, the green economy, job creation, and labor rights issues. Meanwhile, the documentary research focused on evaluating significant documents related to public policies and practices implemented in the renewable energy sector. It is important to highlight that these methods are fundamental for providing a comprehensive and in-depth understanding of the effects of these transformations on the labor market, as well as on the promotion of an equitable and sustainable development model.

The general objective of this study was to examine the interconnection between renewable energy advancements, job creation, and labor rights, assessing their implications for promoting sustainability and social equity. The specific objectives are as follows: to analyze the impact of the energy transition on job creation and the restructuring of the labor market; to investigate how the transition to a green economy affects job security and stability, considering the main challenges to ensuring labor rights in the renewable energy sector; and to evaluate the contribution of the green economy to promoting social justice and reducing socioeconomic inequalities.

This article is structured into four sections. The first section, **Introduction**, presents the research context and objectives, as well as the methodology employed. The second section, **Material and Methods**, describes the research procedures used, with an emphasis on the literature review and documentary research, analyzing the authors and methodological approaches that underpin this study. The third section, **Theoretical Framework**, discusses the main theories and concepts associated with the green economy, energy transition, job creation, and the protection of labor rights. Finally, the **Final Considerations** section provides a summary of the main research findings, presenting conclusions and suggestions for future investigations on the topic.

## **II. Material And Methods**

The investigation adopted a qualitative approach to analyze the dynamics and processes related to the proposed themes. The methods to be employed will include a literature review and documentary research, both fundamental instruments for knowledge development in qualitative research.

The literature review will be conducted in accordance with the guidelines of Cavalcante and Oliveira (2020), who emphasize the importance of selecting and analyzing scientific production relevant to the subject under study to ensure a comprehensive understanding of current discussions. This procedure will enable a thorough analysis of publications addressing the research object, highlighting methodologies and approaches pertinent to the field.

Additionally, documentary research will be employed, as highlighted by Grazziotin, Klaus, and Pereira (2022), who underscore the significance of analyzing historical and bibliographic documents to understand the contexts and trajectories associated with the theme. This perspective will be essential for comprehending transformations and patterns present in the examined documents, providing a robust foundation for the proposed discussions.

The *Manual of Qualitative Research in Education* by Amado (2017) will also be consulted, offering methodological support regarding the qualitative procedures that guide data analysis and interpretation while considering the specificities and challenges of qualitative research. By integrating these methodologies, the investigation aims to delve deeper into the discussed issues, examining theoretical and documentary perspectives while providing a critical analysis of the studied phenomena.

### III. Literature Review

The current Theoretical Framework is structured into three subtopics, which discuss significant and interconnected elements within the scope of energy transition and the green economy. The first subtopic, "Energy Transition and the Labor Market: Opportunities and Transformations," analyzes changes in the labor market driven by new energy sources, as well as the challenges and opportunities arising from this transformation. The second subtopic, titled "Labor Rights in the Green Economy: Challenges and Perspectives," explores the alignment of labor rights with the evolving reality of the green economy, considering its implications for workers and the potential for the development of these rights. Finally, the third subtopic, "Sustainability and Social Justice: The Role of the Green Economy in Reducing Inequalities," examines how the green economy can foster sustainability and mitigate social inequalities by integrating environmental conservation with social equity. These three subtopics are interrelated, offering a comprehensive perspective on the challenges and opportunities presented by the energy transition within the context of the green economy and the labor market.

#### Energy Transition and the Labor Market: Opportunities and Transformations

The shift toward a new energy matrix, particularly with the adoption of renewable sources, has led to substantial changes in the labor market. The transition from fossil fuels, such as oil and gas, to renewable energies, including solar, wind, and hydroelectric power, is generating numerous new employment opportunities. However, this process necessitates a reformulation of the skills and competencies required from professionals in the sector. According to Yang et al. (2024), the energy transition not only alters energy supply systems but also influences the demand for new competencies across various sectors, ranging from solar panel installation to the management of smart grids. Moreover, workforce adaptation and the training of new generations of professionals are crucial elements for the success of this transition. The impact of this transition on the labor sector is significant. Stritzke et al. (2023) highlight that, beyond immediate job opportunities in the renewable energy sector—such as photovoltaic solar energy—there is an increasing demand for professionals skilled in areas such as sustainable finance and clean technology innovations. In Brazil, solar energy has emerged as a promising field, experiencing a notable increase in investments and projects across multiple regions of the country. Ottonelli et al. (2021) explain how the photovoltaic solar energy sector not only generates employment opportunities but also introduces new business paradigms and fosters technological innovations, which are essential for the advancement of a sustainable economy.

Regarding Brazil's energy transition, Jannuzzi (2024) emphasizes that the country is at a critical stage, necessitating the expansion of professional training and capacity-building programs for renewable energy professionals. Research indicates that, alongside the increasing creation of job opportunities, challenges related to specialized technical training persist, as well as the need for public policies to guide the labor market in adapting to these new demands. The retraining of professionals from traditional energy sectors for employment in renewable energy is one of the primary challenges, particularly in terms of technical education and vocational training programs. The following table (Table 1) summarizes some of the key emerging areas in the energy transition and their effects on the labor market.

Table 1: Employment Opportunities in the Energy Transition

Area of Activity	Employment Opportunities	Main Contribution
Photovoltaic Solar Energy	Installers, maintenance technicians, and engineers for photovoltaic systems.	Otto-nelli et al. (2021)
Energy Technology and Innovation	IT professionals and developers of smart energy solutions.	Stritzke et al. (2023)
Smart Grid Management	Automation experts and managers of electrical grid systems.	Yang et al. (2024)
Public Policy and Sustainability	Consultants and analysts in sustainability and green financing.	Jannuzzi (2024)

Source: Jannuzzi (2024)

This table illustrates how the energy transition directly impacts the creation of new jobs in various sectors, simultaneously requiring professionals to adapt to the new market demands. The development of public policies focused on the training and qualification of workers is a central element in ensuring the maximization of the opportunities generated by the transition to renewable energies.

#### Labor Rights in the Green Economy: Challenges and Perspectives

The growing shift towards a sustainable economy, particularly due to the progress in renewable energy sources, has introduced new challenges in the realization of labor rights. According to Oliveira and Sampaio

(2011), governance in the renewable energy sector requires coordination between public and private actors to develop policies that ensure essential rights for workers, including workplace safety and adequate compensation. However, the sector's adjustment to new requirements and the lack of precise regulations for workers in this emerging market create gaps in the protection of these professionals. Carvalho and Tonial (2023) highlight that, although the renewable energy sector presents significant potential, it still requires effective labor safety policies. This is evidenced by the implementation of "green jobs," which demand formalization and protection through well-defined labor laws.

The regulation of work in the renewable energy sector is one of the main challenges highlighted by Martinez (2019). The author emphasizes that the implementation of labor rights must be aligned with the swift transformations and new dynamics in the labor market, especially concerning the inclusion of emerging technologies and the rise of new work organization models. Advancements in the sector, such as the creation of jobs in solar energy and green hydrogen, demand that labor rights be fairly secured, without disregarding the need to adapt labor laws to new work realities and innovative technologies.

Furthermore, the increasing demand for sustainable occupations requires a substantial effort in the training and education of professionals, as stated by Braghini and Silva (2021). The authors suggest that while the green economy provides new opportunities, it is essential to establish a labor environment that fosters social equity and inclusion in the labor market, ensuring that workers' rights are not compromised in the pursuit of economic sustainability. This commitment must be demonstrated through concrete actions that unite the public sector, private sector, and workers in the transformation process. Sousa (2023) explains that sustainability needs to be analyzed from a transformative perspective in the labor market. Despite the loss of investments in unsustainable sectors and the ethical dilemmas, promoting the creation of new industries and sustainable investments are positive aspects for the development of the green economy. Additionally, to ensure that the benefits of this economy are distributed equitably, it is crucial for the transition to emphasize social equity, as it can generate opportunities for workers in the installation, maintenance, and innovation of these green technologies. Regarding green hydrogen, Pordeus et al. (2024) emphasize that, despite Brazil's considerable potential for the production of this resource, it faces obstacles related to regulation and the promotion of job generation in the field. The lack of public policies aimed at the qualification of professionals and the safeguarding of their rights in the renewable energy sector may hinder the sustainable progress of the green economy. Nunes and Gonçalves (2024) stress the importance of solid regulation to support the sustainable energy transition in Brazil and BRICS countries, ensuring proper protection for workers in the green hydrogen industry.

Table 2: Challenges of Labor Rights in the Green Economy

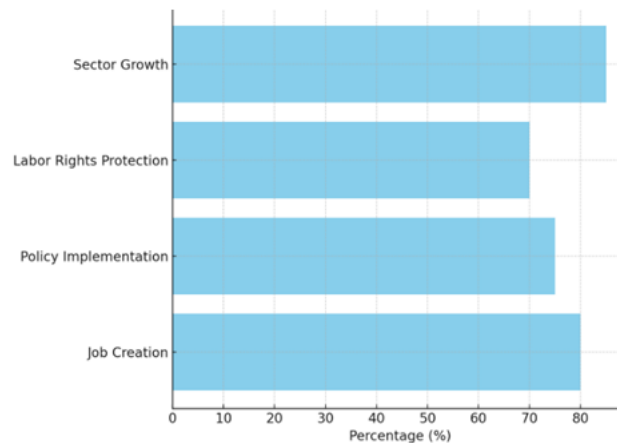
Main Challenges	Opportunities for Improvement	Contributing Author
Lack of clear regulation for solar energy professionals	Creation of specific safety and occupational health policies	Oliveira & Sampaio (2011)
Absence of specific labor qualifications in the green hydrogen sector	Professional qualification programs and incentives for education in the sector	Pordeus et al. (2024)
Lack of public policies to ensure labor rights in the renewable energy sector	Development of agreements between the government and the private sector to guarantee workers' rights	Carvalho & Tonial (2023)
Risk of job precariousness in the renewable energy sector	Establishment of collective agreements that protect workers' rights	Martinez (2019)

Source: Pordeus et al. (2024)

Table 2 provides an overview of the main obstacles associated with labor rights in the context of the sustainable economy, while also suggesting potential opportunities for improvement for each of these challenges, based on contributions from various authors. Among the challenges listed, the regulatory uncertainty for professionals in the solar energy sector, the lack of specializations directed towards green hydrogen, the absence of public policies ensuring workers' rights in renewable energy, and the risk of deteriorating working conditions in this field stand out. For each of the presented challenges, the table proposes actions that can assist in their mitigation, such as the formulation of occupational health and safety policies, the implementation of professional training programs and educational incentives, the development of partnerships between the government and the private sector to guarantee labor rights, as well as the creation of collective agreements that preserve workers' rights. These proposals aim to strengthen the regulation and protection of professionals working in the renewable energy sector, ensuring safer and more stable working conditions. Therefore, the table underscores the need for

greater attention from both the government and businesses in creating a more equitable and sustainable labor environment within the green economy. Graph 1 below offers a percentage analysis regarding the influence of public policies in this sector, considering four key dimensions: sector growth, protection of labor rights, policy implementation, and job generation.

Graph 1: Impact of Public Policies in the Renewable Energy Sector



Source: IEE/USP - Institute of Energy and Environment (2024)

It is observed that the most significant impact of public policies is on the growth of the sector, with a percentage above 80%, demonstrating that the implementation of governmental actions has substantially promoted the advancement of renewable energy. Job creation also shows a significant impact, nearing 80%, highlighting that the adopted policies foster the expansion of opportunities in the job market within this sector. The safeguarding of labor rights presents a slightly lower, but still significant, impact, exceeding 60%, indicating that governmental initiatives have supported the assurance of improved working conditions for professionals in the sector. The implementation of policies reveals the lowest percentage among the four factors evaluated, slightly above 60%, which may signal challenges in the practical application of the regulatory and structural measures required to strengthen the sector. In summary, the graph illustrates that, although public policies have a significant effect on sector growth and job creation, there is still room for improvement in the execution and reinforcement of labor rights protection.

### **Sustainability and Social Justice: The Role of the Green Economy in Reducing Inequalities**

The green economy emerges as a viable option to foster sustainability and social equity, making a significant contribution to reducing inequalities. According to Cunha and Augustin (2014), the concept of sustainable development must encompass, in addition to environmental conservation, the promotion of social inclusion and the maintenance of economic balance. In this way, governmental initiatives aimed at the green economy have the potential to reduce the impacts of inequality by stimulating the creation of sustainable jobs, supporting clean technologies, and ensuring fair participation of the population in economic progress.

Sousa (2023) also highlights that in order to promote fair and equitable labor conditions, it is not enough to face environmental challenges or build green economies; a holistic and sustainable vision of economic development is necessary, one that anticipates the creation of new jobs and the development of skills that improve working conditions, thereby contributing to long-term sustainable economies.

The connection between the green economy and poverty alleviation has been extensively discussed by Silva et al. (2023), who examined the consequences of environmental policies on reducing socioeconomic inequalities. According to the authors, the transition to a sustainable economic model contributes to job creation in areas such as renewable energy, waste management, and sustainable agriculture, mitigating the socioeconomic vulnerability of historically marginalized groups. Furthermore, investment in green infrastructure can strengthen marginalized communities, expanding their access to essential resources and promoting a more equitable distribution of wealth.

Besley and Persson (2023) emphasize that the shift to a sustainable economy is intrinsically linked to political and institutional aspects. The authors argue that the implementation of effective policies requires a balance between the interests of the public and private sectors, ensuring that environmental transformations are accompanied by actions that promote social justice. Therefore, government strategies should focus on regulating and encouraging business practices that favor both environmental conservation and fair socioeconomic development.

According to Khasru and Ambrizzi (2023), a just energy transition is an essential element for social justice within the green economy. The authors suggest that the experiences of Global South countries can offer significant insights into inclusive policies and adaptation methods to climate change. By implementing actions based on these paradigms, both developed and developing countries have the ability to establish a more robust and socially responsible economic environment, ensuring that the ecological transition does not exacerbate existing inequalities.

Finally, Santos et al. (2025) emphasize the relevance of the circular economy as an additional strategy to promote sustainability and mitigate inequalities. The promotion of sustainable production chains and the reuse of resources not only reduce environmental impacts but also generate opportunities for vulnerable groups, boosting productive inclusion and strengthening the local economy. Thus, the green economy stands as an essential foundation for building a sustainable and more socially equitable future.

#### **IV. Conclusion**

The final considerations of this research highlight that all the established objectives were fully achieved, demonstrating the connection between the transition to renewable energy sources, job creation, and labor rights within the context of a sustainable economy. The analysis conducted allowed for an understanding of how renewable energy sources impact the dynamics of the labor market, the obstacles in protecting labor rights, and the role of the green economy in reducing social inequalities.

Regarding the first subsection, titled "Energy Transition and the Labor Market: Opportunities and Transformations," the investigation revealed that the migration towards renewable energy has fostered the creation of new job opportunities, as shown in Table 1: Employment Opportunities in the Energy Transition. The data presented indicated a significant increase in demand for professionals in fields such as solar and wind energy, as well as the need for specialized training to integrate these workers into the labor market. Furthermore, it was found that this restructuring leads to direct consequences in the organization of work and the geographical distribution of occupations.

The second subsection, titled "Labor Rights in the Green Economy: Challenges and Perspectives," discussed the challenges faced by professionals in the renewable energy sector, particularly concerning stability, security, and labor regulations. Table 2: Challenges of Labor Rights in the Green Economy highlighted the main obstacles, emphasizing the precarization of certain labor ties and the urgent need for more effective policies to ensure dignified working conditions. In this context, Graph 1: Impact of Public Policies in the Renewable Energy Sector revealed the importance of public policies in safeguarding labor rights, showing that well-planned government interventions promote sector expansion, worker protection, and the implementation of more efficient regulations.

Finally, the third subsection, titled "Sustainability and Social Justice: The Role of the Green Economy in Reducing Inequalities," demonstrated that the green economy directly contributes to reducing social inequalities by promoting sustainable development alongside job creation and income generation. The study showed that the allocation of resources in renewable energy sources not only stimulates economic development but also strengthens inclusive social policies, creating better living conditions for historically marginalized populations.

In light of these findings, it is suggested that future research explores in greater depth the effects of public policies directed at regulating labor in the green economy, as well as the role of new technologies in training and developing professionals in this sector. Additionally, comparative analyses across different nations could offer valuable insights into effective models of energy transition and socio-economic inclusion.

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