Green Economy—Green Jobs in the Context of Sustainable Development

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Abstract: Europe is in the middle of an energy crisis, exacerbated in large part by skyrocketing gas costs. Renewable energy is critical in this environment for decreasing Europe’s reliance on imported energy; boosting renewables in Europe requires a ‘New Energy Compact’—a coordinated effort throughout Europe to build more renewable energy capacity. The purpose of this research is to examine the structure of renewable energy production in Romania between 2010 and 2020, as well as the green employment produced by the renewable energy sector in Romania between 2010 and 2019. Using the Markov chain approach, it was predicted that in 2025, the hydropower industry’s employees would account for the biggest proportion of the overall average number of workers engaged in the renewable energy production sector in Romania (74.68%). Solar energy production employees will account for 14.31% of the average number of workers in the renewable energy production sector, biomass energy production employees will account for 5.8%, and wind energy production employees will account for 5.2% of the average number of workers in the green energy sector.

Keywords: green growth; green jobs; energy production; renewable sources

1. Introduction

Over time, economic expansion has led to an increase in both resource consumption and the volume of pollutant emissions. The first questions regarding the existence of the limits of economic growth were put forward in 1972, in the paper named “Limits of Growth” [1]. Thus, focus was set on the growing trends of world population, pollution, industrialization, production and depletion of resources, which will result in a sudden and uncontrollable decline in both industrial capacity and population. This paper managed to draw the attention of the whole world towards the existing economic growth model and represents the moment when the public debate shifted its focus from the concept of “economic growth” to that of “economic development”.

Following the publication of this paper, the literature has significantly developed and numerous international summits have been organized. In addition, many studies have been published highlighting the importance of transforming the economic growth model used into one that includes the environmental as well as the social dimension, and establishing a relationship between the environment and development.

The term “green economy” was first used in a 1989 paper named “Blueprint for a Green Economy” by a group of economists for the United Kingdom government. Except for the title, the paper does not contain another reference to the green economy [2].

The concept was brought to global attention in 2008 in the context of the measures taken in response to the global crisis. The United Nations Environment Program defines
the green economy as: “one that results in improved human well-being and social equity, significantly reducing environmental risks and ecological deficit. It generates low carbon emissions, is resource efficient and socially inclusive” [3].

The concept of the green economy has become increasingly important within international public and political discussions, since the 2008 financial crisis. Envisaging the transition to a resource-efficient, sustainable and inclusive social model, countries have developed and promoted numerous initiatives and strategies. Both in those measures as well as in other public policy documents, the central role of green jobs is acknowledged [4–8].

Definitions of the “green economy” concept have been developed by the United Nations Environment Program, the Coalition for the Green Economy, the International Chamber of Commerce, the Danish Group 92, the International Program on Human Dimensions on Global Environmental Change, Karen Chapple, the European Environment Agency, and Karl Burkart.

Karl Burkart [9], researching in the field of environmental relations, climate change, energy and technology, considers the green economy to cover six important areas: renewable energy; “green” constructions; alternative fuels; water management; waste management; and territorial management. He also identified a seventh sector, “green markets”, which includes banking services and various green investments.

The green economy is characterized by a considerable increase in investment in economic sectors that create and consolidate the natural capital of the Earth or contribute to reducing environmental deficiencies and environmental threats. These sectors include, in particular, renewable energy, low-emission transport, energy-efficient construction, clean technologies, improved waste management, sustainable agriculture and forest management and sustainable fishing [10,11].

The Rio + 20 Conference identified potential directions for implementing the concept of the “green economy”, emphasizing the need to continue to promote sustainable development by focusing on key issues, namely poverty eradication, ensuring intergenerational justice, economic efficiency and fairer access to resources [12].

Recently, the idea of “green growth” has been strongly debated in the European Union, being seen as a more sustainable way of economic development and more in line with environmental challenges [13,14]. The concept of the green economy aims at economic transformation in order to promote the improvement of social welfare and justice, while significantly reducing environmental threats and environmental deficiencies [15–18].

In order to support the transition to a sustainable society by changing the way we use technology, and also in the field of social equity, to meet the needs of employment and provide decent and sustainable jobs, the European Union approved the Green Pact in 2019, for the multiannual financial framework 2021–2027. This Pact promotes clean energy production [19], smart cities and the well-being of businesses and professionals in Europe [20]. There are currently significant imbalances in the employment process in the EU, which is why a new funding mechanism has been introduced, the Recovery Plan for Europe, which also covers support for ensuring green and sustainable growth by financing EUR 1.8 trillion. In addition, the following fronts of progress have emerged during recent months: the proposal and launch of the Climate Law in some countries [21], “the development of a sustainable blue economy in the EU for industries and sectors related to the oceans, seas and coasts” [22], the strategy for zero pollution for air, water and soil [23], or the Ecological Action Plan [24].

Regarding renewable energy and its importance for the EU’s green targets, we note that the share of renewable energy (RES) in the transport sector reached 8.9% in 2019 in the EU, 1.1% below the target of the Renewable Energy Directive (RED) for 2020 [25]. The share of RES energy in final electricity and heating and cooling consumption is 34% and 22%, respectively [26]. Increasing the share of renewable energy would bring several benefits, such as economic growth and new employment opportunities, reducing dependence on energy imports, sustainable development of rural areas, improving human welfare and the reduction of GHG emissions and air pollution. Moreover, the transition to a sustainable and
more efficient energy system in the EU would increase security of the energy supply [27]. Europe is in the middle of an energy crisis, exacerbated in large part by skyrocketing gas costs. The advent of conflict in Ukraine has worsened this, underscoring Europe’s 90% reliance on imports. Renewable energy is critical in this environment for decreasing Europe’s reliance on imported energy.

Regarding Romania’s situation, Pirvu et al. [4] made forecasts on the production structure for 2025 by analyzing the structure and dynamics of renewable energy production in the period 2010–2020 using the Markov method. According to them, hydropower has been, and will continue to be, the most important clean energy produced by Romania. The forecast for 2025 keeps it in first place in size of the structure of green energy production, with a percent of 50.266% of the total amount of renewable energy produced in 2025, but the trend is a decreasing one with the background of the increase of wind energy production and solar. According to the mentioned study, the forecast for the year 2025 regarding wind energy is that it will represent 39.156% of the total renewable energy production of Romania. Solar energy is estimated to account for 7.766% of total green energy production in 2025, and biomass energy is expected to account for 2.812% of total renewable energy production.

These concerns are not limited to Europe. According to Kayani [28], the United Arab Emirates (UAE) is committed to the adoption of renewable energy, given that, by the year 2017, 90% of the energy used was in the form of natural gas. Thus, in 2017, the UAE established the Energy Strategy 2050, which aims to combine, in the future (up to 2050), four types of energy: renewable energy (44%), natural gas (38%), “clean” coal or without carbon dioxide (12%) and nuclear energy (6%).

According to Xu et al. [29], the data provided by the National Energy Administration showed that China installed a share of 39.5% renewable energy in total installed capacity by the end of 2019, with a power of 794 million kW. But there are still issues in the development of renewable energy, both in terms of solar photovoltaic energy, wind energy and government support.

There are also major concerns for green jobs. United States higher education institutions (especially universities and colleges) are active in creating, sustaining and maintaining green jobs. Cornell University is an example of this, at the initiative of which gas emissions have been reduced by 30% since 2008. Another example in this regard is the Climate Leadership Network, launched in 2015. It is a network of 650 colleges and universities that aims to reduce emissions and accelerate research and education in the field of sustainable development and green job creation [30].

In the Republic of Mauritius, the International Labour Organization found out that there are opportunities to create green jobs, but that there is still much to be done. In the textile sector, solar panels are used for water heating and natural air-cooling practices. In 2010, 6.3% of all jobs were considered green jobs, i.e., approx. 558,100; in the electricity sector, 23% of jobs were green; and in agriculture, only 12%, while in the textile industry, 5% [31].

Song et al. [32] shows that the Korean Green New Deal Initiative estimated a total of KRW 42.7 trillion needed to create 659,000 green jobs in the green transition of infrastructure and the energy sector by 2025. However, experts believe that the figures are unrealistic because it was a top-down proposal and did not take into account the real supply and demand of the market.

Thus, the transformation of the economic model into a green one is both a challenge and an opportunity for the labor market, as well as for the necessary skills to be acquired, which, in turn, are key aspects of green growth [33]. The transition to a low-carbon, inclusive and sustainable economy will lead to fundamental transformations across the economy, as well as across multiple economic sectors: new jobs will be created, some jobs will be replaced or disappear, and others will be redefined [34–36].

Such a transformation must be achieved primarily through “green” investment, creating “green” jobs, and creating a market for new products (e.g., the market for ecosystem services)
that supports international trade and the so-called circular economy. An important goal of the green economy is also to fight poverty and provide support to developing countries.

Green jobs contribute to increasing the efficiency of natural resource use, limiting GHG emissions, improving energy efficiency, reducing waste and pollution, conserving and, where appropriate, restoring the environment, protecting ecosystems, supporting and mitigating the impact of climate change. Green jobs are often presented as a step forward in creating solutions to both the economic recession and the current environmental crisis, because they are created in the context of sustainable energy development and climate change [37]. Barbier [38] considers that terms such as “green jobs”, “clean economy” and “green growth” have become particularly important in the ideology and programs of states, governments and international organizations that adopt and implement “growth strategies that promote energy security and environmental protection”.

Most research examining the relationship between clean energy and employment appreciates the existence of a great potential for creating green jobs in the future [39–41]. We have identified interesting studies in this regard, aimed at focusing on the impact of investment in renewable energy [42,43], and environmentally friendly technological innovations in the growth of green jobs [44]. However, the literature indicates significant gaps in knowledge in the field, due to the use of various approaches in defining green jobs, with different spheres of coverage, and due to the wide variety of relevant policies used. The growing share of renewable energy in total energy production and rising global energy consumption is leading researchers to focus more and more on analyzing the link between renewable energy sources and production and job creation in those industries [45].

The green economy is thus considered the key solution for achieving growth and creating new jobs by increasing energy efficiency, efficient use of natural resources, protecting the environment, exploiting renewable resources in energy production, becoming more suitable to the effects of climate change, reducing waste and its recycling, as well as protecting the planet’s biodiversity [46,47]. The green economy is also seen as the way to achieve the goals of sustainable development [48–50].

The 2015 Paris Agreement on Climate Change, the UN Sustainable Development Goals and the Special Report of the Intergovernmental Panel on Climate Change call for decisive and accelerated action to reduce GHG emissions and make the economy resilient to climate change [51]. Seeking to meet these goals and implement them in measures of economic policies, the European Union has included green growth in the objectives of the 2020 Strategy. This goal is in line with those of the Organization for Economic Cooperation and Development [52] and the United Nations Environment Program [53].

The European Union has subsequently set ambitious targets for 2030 in terms of renewable energy use, reduced GHG emissions and increased energy efficiency [54]. To achieve this goal, in 2018, the European Commission developed a strategy to transform the economy into a competitive, prosperous, modern and climate-neutral economy by 2050 [55]. Although, as we have mentioned before, there is no consensus on the definition of green jobs, they are considered to be those jobs that aim to improve environmental conditions, reduce pollution and waste, improve energy efficiency, and reduce material consumption, limiting emissions and supporting adjustment to the consequences of climate change. They are found, in particular, in new economic sectors such as renewable energy production.

We appreciate that the investments made in the public and private sectors in the field of green growth will determine the creation of new jobs (the so-called “green jobs”) in different and numerous sectors of the green economy [56–59]. As a considerable part of the green jobs are those created in the renewable energy sector, our research aimed to analyze the green jobs generated by the industry producing electricity from renewable sources in Romania.

The aim of the paper is to analyze the structure of energy production from renewable sources in Romania during the period 2010–2020, and the green jobs generated by the industry producing electricity from renewable sources in Romania, between 2010–2019. The trend of the employment structure on the four renewable resources exploited by
Romania is forecast for the year 2025 using the “Markov Chains” method. This paper is divided into five sections, starting with an introduction in Section 1, and followed by an in-depth documentation of materials relevant to the field researched, followed by the selection and systematization of information on the green economy, renewable energy and (green) jobs in Section 2. Section 3 includes information on the sample and model, followed by results and discussion in Section 4. The last section (Section 5) unveils the main conclusions of the research.

2. Literature Review

Although the idea of sustainable development is not new, the approach and interpretation are constantly changing, in line with economic, social and environmental challenges, but also with the immediate and long-term goals pursued by those involved in the field. Currently, research on the green economy, in the context of balanced and equitable development, focuses on the various links between increasing productivity, tackling innovative and sustainable production methods, moving towards the circular economy, and replacing current jobs with green ones.

For a clean and competitive economy, the European Union promotes transition from the traditional, linear economic model to a new, pro-environment, more sustainable economic model, that is one of the circular economies. This is based on innovation, involves the use of new technologies and new models in business and offers opportunities for rapid growth, increased competitiveness, job creation and conservation of natural resources, with the ultimate goal of sustainable development and increasing the quality of life.

All actors need to contribute to achieving an appropriate framework for the new green economy, and public and private investment is needed.

Because energy plays an important role in economic growth but, at the same time, has a definite impact on the environment, various studies regarding the link between renewable energy consumption and growth try to provide solutions to eliminate the negative effects on nature and the potential role of green energy, while attracting decision makers, businesses and economists from around the world. The methods used for the analysis of the variables considered are not identical, but the conclusion is the same: in order to ensure sustainable growth, the consumption of renewable energy must be encouraged, by allocating the necessary funds for the development of green projects.

Thus, examining the link between renewable energy consumption and economic growth in traditional European production, Kasperowicz et al. [59] notes that there is a long-term cointegration relationship between these variables. Consequently, renewable energy consumption and gross fixed capital have a positive influence on the long-term economic growth of European countries. Saad and Taleb [60] also analyze the relationship between renewable energy consumption and economic growth in 12 EU countries between 1990 and 2014. The results show that a stimulus in economic growth determines the consumption of renewable energy and vice versa. This reveals the growing role of renewable energy sources in stimulating long-term growth in the targeted areas.

In their paper, Asiedu, Hassan, and Bein [61] investigate the relative effect of non-renewable resources and renewable energy on economic growth. Benjamin Ampomah Asiedu’s conclusion is that there is a long-term balance between economic growth and independent variables: renewable energy consumption, non-renewable energy consumption and CO\(_2\) emissions. Thus, the results indicate a two-way causal relationship between growth and renewable energy consumption and a one-way causal relationship between renewable energy consumption and non-renewable energy consumption, as well as between renewable energy and CO\(_2\) consumption. An increase in the consumption of non-renewable resources and the consumption of CO\(_2\) emissions leads to a decrease in economic growth, and sustained economic growth generates an increase in the consumption of renewable resources, between which there is an interdependent relationship.

PotršŠ., Čuček L., Martin M., and Kravanja Z. (2021) [27] examine sustainable renewable energy supply networks in the EU-27 and propose the transition to renewable...
energy sources in the transport and energy sectors. The authors develop a multi-period programming model, taking into account different biomass and waste resources for the production of biofuels, renewable electricity, hydrogen, food and bioproducts, using different types of technologies. The results show that, with the continued development of existing technologies, the goal of a carbon-neutral EU can be achieved without compromising food production. In addition, the transition to renewable energy sources in the EU could have a significant positive impact on the economic, environmental and social aspects of sustainable development with over 1.5 million new job opportunities created in the EU over the next 30 years.

Aceleanu et al. [62] point out that in Romania, there is an important link between the share of renewable resources in gross final energy consumption and the country’s dependence on imports. The study also concludes that Romania, through its multiple sources of renewable resources, has the capacity to develop its rural environment by using the energy obtained from these resources.

Even if the impact of the use of renewable energy, capital and labor on economic growth is generally positive, especially for those nations that already use renewable energy sources and benefit from their positive effect, they can create jobs and achieve economic growth. Shahbaz et al. [63] point out that there are also some situations in which nations have not benefited from such advantages: this is the case for states with an energy mix—natural gas, crude oil, coal, etc.—where the share of renewable energy consumption is low, so it has a negative impact on economic growth or the case of states that didn’t opt for producing renewable energy sources for economic production, which are based on foreign trade and, therefore, the consumption of renewable energy will not have a considerable impact on economic growth. Shahbaz et al. consider that the relationship between renewable energy and economic growth is dynamic and that green technologies need funding to be integrated into industries.

In the context of sustainable development and Europe’s transition to an efficient, circular economy, Sulich and Rutkowska [64] propose the creation of green jobs as a solution to the unemployment problem and show that they contribute to the added value of the environmental goods and services sector (EGSS), and also of GDP. In fact, green jobs are the result of the emergence and development of new technologies and, at the same time, of trying to achieve a compromise, a balance of generating and absorbing pollutants in the traditional economy.

In order to be able to present the link between the creation of green jobs and this new economic model, of the circular economy, especially within the sector of environmental goods and services (EGSS)/sector of eco-industries—as a specific sector of green jobs—Sulich and Soloducho-Pelc [65] analyzed, over a period of 10 years, the EGSS in the Member States of the European Union and developed a model in which they identified three variables of influence—areas of strategic management—in the creation of green jobs: private investment, jobs and gross value added related to the sectors of the circular economy; and patents that focus on recycling and the use of secondary raw materials and the recycling of bio-waste. Thus, they consider that the implementation of the circular economy concept is imperative; green jobs have increased due to technological change and investment in environmental protection and resource management activities, and can be used as tools to implement the circular economy, protecting the environment and providing solutions to climate and economic crises.

Regarding the use of the circular economy and effects on employment, Moreno-Mondejar et al. [66] argue that circular economy models are more likely to create green jobs. Moreover, they prove that the number of green jobs or the probability of their creation at company level differs depending on the type of strategy chosen by the circular economy—the 4Rs—the level of circularity, and also the actors involved. The study also shows that large firms are more likely to create green jobs because the size, resources, and technological and organizational capabilities of a firm are key factors in the likelihood of creating green jobs, and also of the number of jobs.
Šimelytė and Dudzevičiūtė [67] explore the links between renewable energy consumption, growth, trade, capital and labor. Their study covers 28 countries in the European Union, for the period 1990–2012, and shows that, in general, renewable energy consumption and growth in the EU have a strong relationship. In any case, increasing renewable energy consumption by 1% would reduce the EU’s economic growth by 0.130%. There has been a strong relationship between renewable energy consumption and trade and capital formation. In addition, a moderately strong link between renewable energy and employment in the EU has been indicated.

As already mentioned in the introduction, there are various approaches to defining green jobs. In this regard, considering green jobs as those related to the renewable energy sector, Kulyk et al. [68] demonstrate in their study that renewable energy sources are an important tool in increasing employment. The Renewable Energy System (RES) produces more jobs than the traditional energy sector, and due to the large dispersion of production and jobs, it also generates new jobs in smaller cities or rural areas, where the issue of unemployment is pressing. Other current studies also link renewable energy to employment. Thus, analyzing the situation of Poland, but also of the entire Visegrad Group, Kulyk et al. [68] noted that the development of renewable energy and the emergence of green jobs depend on a number of factors, such as the diversity of resources, the energy efficiency of the state, the prices of innovation, the administrative solutions adopted or proposed, etc.

On the other hand, to see if there was a causal link between renewable energy and US employment, Çelik [45] started from a statistical hypothesis and developed a spectral analysis of Granger’s Causality Test. According to the study, in the period 1973–2019, there is no causal relationship between obtaining renewable energy and American employment, the two variables being neutral. According to Çelik, this lack of causation could be explained by the low share of renewable energy consumption in the period under review. However, he believes that supporting investments in renewable energy and providing incentives could increase US employment.

Studying the case of Czech Republic, Dvořák et al. [42] show that the use of renewable sources has led to the creation of an important number of jobs, especially in the bioenergy subsector. They also highlighted the role of financial incentives, investment and benefits in job creation in rural areas.

The development of renewable energy requires a joint effort that involves institutional, legislative and financial aspects. According to this study, it is necessary to support a growth of jobs in the renewable energy sector by stimulating workers to acquire special skills and qualifications, educating the public about the benefits of development renewable energy and encouraging the production facilities necessary for green energy generation.

Connolly et al. [69] had a hybrid approach in observing the evolution of green jobs in Scotland. Even though, according to the analysis, the employment in the activities of Low Carbon Environmental Goods and Services (LCEGS) increased in the period 2004–2012, things are more complicated. In fact, as renewable energy sectors reach technological maturity, the number of people employed is lower, as not all construction activities are required, only maintenance/service activities. Connolly et al. (2016) [55] conclude that it is not the total number of jobs that is most important, but the types of jobs created and the dissemination of the effects in the economy.

Pașnicu and Ciucă [70] noticed a series of structural imbalances in the Romanian labor market, which can be highlighted by the adoption of green acquisitions. Currently, there are imbalances in the employment rate of young people, the elderly and those in rural areas, as well as a lack of coordination of educational offers with the requirements of the labor market. Green jobs are found in both traditional and new sectors of a national economy and, as Rutkowska-Podołowska et al. [71] concluded, they are a solution to the unemployment situation among the young population, to the improvement and protection of the environment and to international collaboration, through the exchange of technologies, knowledge and expertise. Labor supply and demand act simultaneously, giving a specific
dynamic to the labor market; thus, their balancing influences the economic and social development, both in the short and long term.

Song et al. [32], analyzing online recruitment services in the South Korean labor market, showed that the mismatch between supply and demand for green jobs is noticeable in terms of pay, time synchronization, regions and sectors, especially as it requires a certain level of expertise. A jobs mismatch can affect labor productivity and lead to an increase in unemployment in the green job market. The study shows that most green jobs in South Korea are related to water and air quality, and a correlation between them can increase the quality of the environment, reduce the number of unemployed and increase sustainability through jobs and business. A synchronization of supply with the demand for green jobs provides information necessary for good collaboration between all parties involved: job seekers, potential employers, central and local government, and also academia. Sulich and Zema [72] support the role of green jobs as an indicator of assessing balanced and sustainable development, both in relation to the green economy and the theory of New Public Management. For this reason, they pointed out in their analysis the need for a measurable definition of green jobs.

Community initiatives, such as the European Green Pact or the National Recovery and Resilience Plans, enable European countries to become more competitive and resource-efficient. The European Union’s actions have also been analyzed in relation to green jobs. García Vaquero et al. [20] points out that the implementation of the Recovery, Transformation and Resilience Plan in Spain will contribute to the creation of 356,000 green jobs—directly and indirectly—involving a highly skilled workforce, software skills, innovative capacity, thinking criticism and, where appropriate, retraining. The implementation of the Recovery Plan in Spain and the policies supported by the European Green Pact are also developed by Arnedo et al. [73], which paid more attention to the issue of green jobs in the tourism market—especially in the hotel industry. According to the study, the number of possible green jobs in the hotel sector is relatively small, with most green activities being outsourced. In this case, we will see more of an inclusion of green jobs in traditional job profiles; that is, educating and developing new skills related to the green economy. Thus, Arnedo et al. [73] conclude that the changes imposed by the digital transition must also be taken into account in the hotel sector, by approaching the gig economy with a collaborative, flexible approach to the issue, in which the quality of services plays a central role.

Taking into consideration the issue of green jobs in a green economy, aiming at sustainable development, their relationship with universities and research departments, as trainers and more, should not be overlooked. Higher education institutions, including research centers, play an active, innovative role in the development of the local economy, so Lee and van der Heijden [30] suggest that green jobs in cities are positively influenced by their presence as they prepare future employees with ecological skills, form links between them and the business environment concerned, and also provide knowledge and research related to environmental protection, greening and sustainable development. In addition, all actors believe that the system of university governance needs to be reconfigured in order to provide green knowledge and ensure innovation, as shown by Liyanage et al. [74].

3. Materials and Methods

Renewable energy sources are increasingly used by many countries because they are clean, sustainable and have less of a negative effect on the environment. Interest in sustainable development has accelerated the consumption of renewable energy in recent decades, and many countries are turning to new energy sources to reduce the harmful effects of non-renewable energy on the economy and the environment. Thus, the selection of economic operators included in the research has as a criterion the specificity of the production of energy from renewable sources, taking into account four types: hydro, wind, solar and biomass. The economic-financial information that constituted the research database is provided by the Ministry of Finance and refers to the economic entities that
transmit information through the annual financial accounting reports, the National Energy Regulatory Authority, the National Institute of Statistics and the data published on the site.

At national level, the support of the Romanian Government for energy production from renewable sources started in 2005, when they adopted Decision no. 1892/2004. In 2010, the National Energy Regulatory Authority authorized 166 economic operators to produce electricity from renewable resources. The number of entities active in the field of green energy production has continued to grow, reaching in 2019 a number of 639 producers authorized by the National Energy Regulatory Authority.

The research methodology of the dynamics of the labour force employed in the green energy production sector is carried out in the following stages:

- The production of electricity from renewable sources is extracted from the database provided by Transelectrica, on the four types of resources: wind, solar, hydro and biomass, in the period 2010–2020;
- The economic operators whose main object of activity is the production of electricity (CAEN code 3511) are identified from the database of the Ministry of Finance;
- Afterwards, only the entities accredited by the National Energy Regulatory Authority to produce electricity from renewable energy sources are filtered and retained from the resulting database;
- For the entities mentioned above, the average number of employees for the period 2010–2020 is identified in the database of the Ministry of Finance;
- The average number of employees in the renewable energy production sector is calculated, in the four types of renewable sources, in the period 2010–2020;
- The structure of the workforce employed in the renewable energy sector by types of energy used for the year 2025 is forecasted, using the “Markov Chain Method”.

The analysis of the dynamics of the labor force employed in the field of renewable energy, from a structural point of view by types of energy, is oriented, based on the data collected, to 5-year intervals to capture the most significant changes that have occurred. At the same time, it will provide the necessary statistical basis for forecasting the structure of employment in the renewable energy production sector in 2025. The analysis takes into consideration a transitory factor that influenced the structural changes in previous years.

The analysis and forecast of the structure of the average number of employees in the field of renewable energy by type of source will be conducted using the “Markov Chain Method”, which consists in first determining a number of \( n - 1 \) transition matrices \((3 - 1 = 2)\). Each transition matrix identifies the structural changes that have occurred from one time segment to another. Based on these sequential matrices, the total transition matrix is calculated, and then the transition probability matrix. The matrix of the average probabilities of changing the structure of the average number of employees in energy production from resources considered renewable from one time segment to another is the mathematical basis for calculating the predictable structure in 2025.

3.1. Preliminary Statistics—Renewable Energy Production in Romania

The use of alternative resources to fossil fuels is the most appropriate solution for air pollution. These include the sun, wind, water and biomass. The most important advantages of using these resources are their clean nature, renewability and very high availability, being found anywhere in the world.

In a green economy, the energy system must increasingly rely on the use of renewable and non-polluting resources. At the national level, the share of energy from renewable sources in 2010 was 33.58% of total energy production. In the following period, green energy registered an increasing trend, reaching in 2020 a percent of 44.87% of total energy production.

As renewable sources, Romania uses for energy production, in particular, hydropower, followed by wind energy, as well as solar energy and that obtained from biomass.

In order to meet its commitments and make the transition to a green economy, the share of energy from clean sources must maintain its upward trend in total energy production,
and the amount of fossil fuel energy must decrease. In 2008, the Romanian Parliament adopted Law no. 220/2008 to encourage and stimulate the private sector to invest in the use of renewable resources for energy production. The normative act in question regulates the system for promoting the exploitation of renewable energy resources by granting green certificates to clean energy producers. In addition, Law no. 220/2008 establishes the mandatory annual quotas of green energy produced, for which green certificates are granted (Table 1).

**Table 1.** Mandatory annual quotas for energy produced from clean sources.

| Year | Quota (%) |
|------|-----------|
| 2010 | 8.3%      |
| 2011 | 10%       |
| 2012 | 12%       |
| 2013 | 14%       |
| 2014 | 15%       |
| 2015 | 16%       |
| 2016 | 17%       |
| 2017 | 18%       |
| 2018 | 19%       |
| 2019 | 19.5%     |
| 2020 | 20%       |

Source: Law no. 220/2008 for establishing the system for promoting the production of energy from renewable sources.

This law also establishes our country’s target for the share of energy from clean sources in the final gross energy consumption for 2020, namely 24%. In Romania, during the period 2010–2020, the dynamics of production regarding the four types of renewable sources expressed in MW is presented in Table 2.

**Table 2.** Dynamics of energy production from renewable resources by types of energy.

| Indicator | Renewable Energy Production (Mw) |
|-----------|----------------------------------|
|           | 2010    | 2015    | 2020    |
| Total     | 116,559,247 | 153,493,080 | 77,039,446 |
| Hydroelectric | 115,014,069 | 101,584,830 | 47,051,215 |
| Wind      | 1,545,178  | 41,047,259 | 23,959,812 |
| Solar     | 0        | 7,561,257  | 4,532,671  |
| Biomass   | 0        | 3,299,734  | 1,495,748  |

Source: authors’ processing, based on data published on the Transelectrica website.

As percentages, the dynamics of the structure of energy production from renewable sources, taking into consideration the four sources exploited by Romania in the period 2010–2020, is presented in Table 3.

**Table 3.** Dynamics of the structure of energy production from renewable resources by types of energy.

| Indicator | Renewable Energy Production (%) |
|-----------|---------------------------------|
|           | 2010 | 2015 | 2020 |
| Total     | 100.0  | 100.0  | 100.0  |
| Hydroelectric | 98.7  | 66.2  | 63.8  |
| Wind      | 1.3  | 26.7  | 28.6  |
| Solar     | 0  | 5.0  | 5.9  |
| Biomass   | 0  | 2.1  | 1.9  |

Source: authors’ processing, based on data published on the Transelectrica website.

3.2. Greening Employment—The Analysis of the Dynamics of the Structure of Green Jobs in the Sector of Electricity Production from Renewable Sources

The national clean energy sector is probably the most important sector of the green economy in Romania. At the end of 2020, there were a total of 762 entities that exploited the potential of our country in terms of renewable energy production. The future investments
estimated by the National Recovery and Resilience Plan (2021) (NRRP) are considerable and will determine, among other things, the increase in Romania’s green job creation potential. The budget proposed in the NRRP for the transformation of the energy sector into a green one is EUR 1.62 billion and aims to replace the energy based on coal with the energy produced from renewable sources, increase energy efficiency in industry, and stimulate the growth of electricity transport.

The National Recovery and Resilience Plan (NRRP) mentions some of the expected results in the energy field as a consequence of the implementation of the plan. These results refer to the increase of the installed capacities for renewable energy production (solar and wind) from 4408 MW to 5908 MW, and to the increase in Romania’s energy storage capacity in order to integrate wind and solar capacities into the electricity grid. All these investments will also generate decent and sustainable jobs that will help restore and preserve the environment.

At this moment, it is difficult to estimate the total number of green jobs in Romania. However, the National Institute of Statistics (NIS) calculates an indicator, taking into consideration the population that is employed in the environmental goods and services sector. The evolution of this indicator, during the period between 2011 and 2018, is presented in Table 4.

Table 4. Human resources (HR) employed in the environmental goods and services sector, in the period 2010–2018.

| Indicator                                         | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------------------------------------------------|------|------|------|------|------|------|------|------|------|
| HR employed in the environmental goods and services sector | 233  | 236  | 215  | 206  | 195  | 178  | 148  | 140  | 144  |

Source: authors’ own processing, according to the data presented by NIS.

Analyzing the data reported by the NIS, Romania has faced a decreasing trend in the evolution of employees in the environmental goods and services sector. The comparison showed that at the end of 2010, the population employed in this sector was 233,184; at the end of 2020, the population employed in the same sector was 144,552. The percent decrease in the population employed in the environmental services and goods sector was 62%.

The distribution of employees in this sector by environmental domains is displayed in Table 5.

Table 5. Distribution of the population employed in the environmental goods and services sector by the main environmental activities.

| Preserving Environment Activities | 2010    | 2011    | 2012    | 2013    | 2014    | 2015    | 2016    | 2017    | 2018    |
|----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Air and climate quality          | 49.37   | 29.39   | 8.18    | 15.28   | 11.11   | 13.83   | 11.40   | 13.09   | 12.03   |
| Wastewater management            | 7.24    | 19.64   | 7.82    | 6.69    | 4.95    | 8.58    | 4.67    | 4.75    | 5.71    |
| Waste management                 | 43.86   | 48.07   | 53.68   | 40.57   | 37.58   | 37.09   | 41.54   | 36.73   | 38.15   |
| Protection and remediation of soil, groundwater and surface water | 23.77   | 45.78   | 25.24   | 25.40   | 33.83   | 25.76   | 27.59   | 27.48   | 27.16   |
| Other Preserving Environment Activities | 0.50   | 2.71    | 0.46    | 1.15    | 0.97    | 1.37    | 0.94    | 0.98    | 0.52    |
| Water management                 | 3.78    | 1.45    | 3.84    | 3.80    | 2.07    | 4.60    | 2.75    | 2.74    | 3.95    |
| Forest resources management      | 61.51   | 53.50   | 70.88   | 68.38   | 59.35   | 40.34   | 24.84   | 23.82   | 24.66   |
| Energy resources management      | 0.00    | 30.83   | 38.25   | 37.79   | 38.95   | 33.56   | 30.88   | 27.30   | 28.17   |
| Other resource management activities | 7.19   | 4.35    | 6.99    | 6.80    | 5.73    | 12.38   | 2.97    | 3.16    | 3.20    |

Source: authors’ own processing, based on data reported by NSI.

The largest share of the population employed in the environmental goods and services sector is in forest resources and waste management. With the lowest share, we find other activities related to preserving the environment, wastewater management and other activities related to resource management.
The largest decrease in the population employed in the environmental goods and services sector in 2018, compared to 2010, is recorded in the case of forest resources management activity (40.09%), followed by activity in air and climate quality (24.38%). The activity related to the remediation and protection of soil, groundwater and surface water, as well as that of other preserving environmental activities, are the only activities that recorded an upward trend in the population employed in the environmental goods and services sector in 2018, compared to the year 2010.

Considerable investment is required for activities in the field of waste and renewable energy management, research and innovation, agriculture, afforestation, tourism, and increasing energy efficiency, as set out in the New European Green Pact, the National Sustainable Development Strategy and the Action Plan for the Implementation of the National Strategy for Green Jobs 2018–2025, which will lead to an increase in the population employed in these environmental fields.

One of the most important sectors of the green economy is the production of energy from renewable sources. In our country, seven resources for electricity production are currently exploited, four of them being considered green sources: water, wind, sun and biomass.

In Romania, at the end of 2020, the productive sector of renewable electricity totaled 762 producers, authorized by the National Energy Regulatory Authority (NERA) to produce energy from renewable sources. They operate a total of 1019 accredited plants with an installed capacity of 4763.5093 MW. The distribution of the 762 accredited producers for the production of renewable energy by the four types of green sources used for electricity production is presented in Table 6.

Table 6. Distribution of economic operators in the green electricity production sector by types of resources exploited.

| Number of Economic Operators | Solar Energy | Hydraulic Power | Wind Power | Biomass |
|------------------------------|--------------|-----------------|------------|---------|
| 633                          | 261          | 92              | 33         |

Source: authors’ own processing, based on data presented by NERA.

The analysis of the dynamics of the labor force employed in the field of renewable energy, from a structural point of view, by types of energy, is focused on the data over a 5-year period to capture the most significant changes that have occurred. At the same time, it will provide the necessary statistical basis for forecasting the structure of employment in the renewable energy production sector in 2025, given the average transition factors that have characterized the structural changes in previous years.

In Romania, during the period 2010–2020, the dynamics of the average number of employees in the renewable energy sector is presented in Table 7.

Table 7. The dynamics of employment in the sector of production of energy from renewable resources by types of energy.

| Indicator                                      | Average Number of Employees in the Renewable Energy Sector |
|------------------------------------------------|----------------------------------------------------------|
| Average number of employees in the renewable energy sector, from which: | 2010 | 2015 | 2020 |
| Hydropower                                      | 5.937 | 4.723 | 4.584 |
| Wind                                            | 5.470 | 3.874 | 3.629 |
| Solar                                           | 93    | 174   | 248   |
| Biomass                                         | 313   | 536   | 524   |

Source: own processing, based on data reported by the Ministry of Finance.
As percentages, the dynamics of the structure of the average number of employees in the renewable energy production sector, by the four sources operated by Romania, in the period 2010–2020, is presented in Table 8.

Table 8. Dynamics of the labor force structure employed in the sector of energy production from renewable resources by types of energy.

| Indicator | The Structure of the Average Number of Employees in the Green Energy Production Sector (%) |
|-----------|----------------------------------|
|           | 2010    | 2015    | 2020    |
| Total average number of employees in the green energy sector, from which: |          |          |          |
| Hydropower | 92.13   | 82.02   | 79.17   |
| Wind       | 1.57    | 3.68    | 5.41    |
| Solar      | 5.27    | 11.35   | 11.43   |
| Biomass    | 1.03    | 2.95    | 3.99    |

Source: authors' own processing, based on data reported by the Ministry of Finance.

3.3. Model and Method

The analysis and forecast of the structure of the average number of employees in the field of renewable energy, by type of source, will be performed using the “Markov Chain Method”, which consists in first determining a number of $n - 1$ transition matrices ($3 - 1 = 2$). Each transition matrix identifies the structural changes that have occurred from one period to another. Based on these sequential matrices, the total transition matrix is calculated. And then the transition probability matrix. The matrix of the average probabilities of changing the structure of the average number of employees in energy production from resources considered renewable from one period to another is the mathematical basis for calculating the forecast structure in 2025.

The transition matrix (1) (Table 9) that expresses the change in the structure of the average number of employees in the production of energy from sources considered renewable, by type of source, is calculated from 2015, in comparison to 2010.

Table 9. Transition matrix (1).

| a     | b     | c     | d     | Year 2010 | Decrease |
|-------|-------|-------|-------|-----------|----------|
| 82.02 | 2.11  | 6.08  | 1.92  | 92.13     | −10.11   |
| 1.57  |       |       |       |           |          |
| 5.27  |       |       |       |           |          |
|       | 1.03  |       |       |           |          |

Source: authors' own processing.

For the calculation of the matrix (1), we used the following indicators:
- $a$ = the share of the average number of employees in the hydropower sector in the total average number of employees in the sector of energy production from renewable sources;
- $b$ = the share of the average number of employees in the wind energy sector in the total average number of employees in the sector of energy production from renewable sources;
- $c$ = the share of the average number of employees in the solar energy sector in the total average number of employees in the renewable energy production sector;
- $d$ = share of the average number of employees in the biomass energy sector in the total average number of employees in the renewable energy production sector.

The most significant change in the structure of the labor force employed in the field of renewable energy production is recorded in the case of the share of the average number of employees in the hydropower sector.
The change in the structure of the average number of employees in the sector of renewable energy production in 2015, compared to 2010, is presented in Figure 1.

![Figure 1](image-url)

**Figure 1.** The dynamics in the structure of the average number of employees in the renewable energy production sector in 2015, compared to 2010. Source: authors’ own processing.

Based on analysis of the transition matrix (1), we observed that the share of the average number of employees in the hydropower production sector decreased by −10.11 percent in 2015, compared to 2010, due to the increase in the share of workers in the field of wind energy by 1.57 percent, in the field of solar energy by 6.08 percent and in the field of energy obtained from biomass by 1.92 percent.

The transition matrix (2) (Table 10) illustrates the change in the structure of the average number of employees in the renewable energy production sector, by energy types, in 2020, compared to 2015.

|      | a     | b     | c     | d     | Year 2015 | Decrease |
|------|-------|-------|-------|-------|-----------|----------|
| a    | 79.17 | 1.73  | 0.08  | 1.04  | 82.02     | +2.85    |
| b    | 3.68  |       |       |       | 3.68      |          |
| c    |       | 11.35 |       |       | 11.35     |          |
| d    |       |       |       | 2.95  | 2.95      |          |
| year | 79.17 | 5.41  | 11.43 | 3.99  | 100.00    |          |
|      | increase | +1.73 | +0.08 | +1.04 |           |          |

Source: author’s own processing.

The same system of indicators used for calculating the transition matrix (1), is also used in calculating the transition matrix (2).

The structural dynamics of the average number of employees in the renewable energy production sector are presented in Figure 2.

The second transition matrix highlights the fact that in 2020, compared to 2015, the share of the average number of employees in the field of hydropower continued to decrease by 1.84 percent. An increase in the share of the total average number of workers in the renewable energy sector is registered in the case of employees in the wind energy sector as + 0.38%, solar energy + 0.11% and energy obtained from biomass + 1.35%. It can also be noticed that the rate of decline in the share of employees in the hydropower sector decreased in 2020, compared to 2015. Thus, in 2015, compared to 2010, the share of employees in the hydropower sector decreased by 10.11 percent, while in 2020, compared to 2015, the decrease was only 1.84 percent.

Given the sequential transition matrices (1) and (2), the total transition matrix (Table 11) is presented below as the sum of the two transition matrices.
The transition matrix (2) (Table 10) illustrates the change in the structure of the average number of employees in the renewable energy production sector in 2020, compared to 2015. Source: authors’ own processing.

|       | a     | b     | c     | d     | Total |
|-------|-------|-------|-------|-------|-------|
| a     | 161.19| 3.84  | 6.16  | 2.96  | 174.15|
| b     | 3.84  | 5.25  | -     | -     | 5.25  |
| c     | 6.16  | -     | 16.62 | -     | 16.62 |
| d     | 2.96  | 3.98  | -     | 3.98  | 3.98  |
| Total | 161.19| 9.09  | 22.78 | 6.94  | 200   |
| increase | +1.73 | +0.08 | +1.04 |       |       |

Source: authors’ own processing.

As the initial fidelity diagonal was not disturbed, during the three years analyzed, in contradictory directions to change the structure of the average number of employees in the renewable energy production sector, in the total transition matrix, the fidelity diagonal consists of the smallest elements of the totals entered on the row and column.

The existence of the smallest values on the fidelity curve/line (diagonal) of the total transition matrix is possible only in the case of a dynamic with a constant sense of change of the relative sizes of the structure.

4. Empirical Results—Estimating the Trend of the Structure of Green Jobs for 2025

We will calculate the transition probability matrix by relating each element on the line to the total line (to increase the accuracy of the projection, the results of the ratios will be recorded to at least five decimal places). The transition probability matrix identifies the statistical legitimacy of the changes that have occurred in the structure of the average number of employees in the sector of energy production from renewable resources during the time-limited period, 2010–2020.

|       | 0.92558 | 0.02204 | 0.03537 | 0.01699 |
|-------|---------|---------|---------|---------|
|        | 0.00000 | 1.00000 | 0.00000 | 0.00000 |
|        | 0.00000 | 0.00000 | 1.00000 | 0.00000 |
|        | 0.00000 | 0.00000 | 0.00000 | 1.00000 |

In order to determine the projection of the structure of the average number of employees in the renewable energy production sector in 2025, for the four types of energy, the transpose of the matrix of transition probabilities is multiplied by the vector of relative structural quantities in the last year of the analyzed period.

|       | 0.92558 | 0.00000 | 0.00000 | 0.00000 | 79.17 | 73.28 |
Estimating the structure of the labor force employed in the renewable energy production sector for 2025, on the four types of energy currently exploited in Romania, namely hydropower, wind, solar and biomass, is presented in Figure 3.

![Figure 3](image-url)

**Figure 3.** Expected structure of the average number of employees in the green energy production sector for the year 2025, in Romania. Source: authors’ own processing.

We can see that the average number of employees in the production of hydropower will continue to decrease and this will reach, in 2025, a share of 73.28% in the total number of employees in the sector of clean energy production. An increase in the average number of employees is observed in the case of workers in the solar, wind and biomass production sectors.

5. **Discussion**

Estimating the structure of the labor force employed in the renewable energy production sector provides decision makers with the information support necessary to substantiate...
and carry out general supply actions with the necessary material resources, as well as to modernize or develop technical endowments related to activities predicted to grow. At the same time, information on the future structure of green jobs in the field of renewable energy production may be seen as the basis for making decisions regarding the necessary green skills of workers in the future.

With the onset of the COVID-19 pandemic, many jobs were lost and the unemployment rate rose. Another consequence of the sanitary crisis regarding the labor market is the decrease in wages for certain categories of employees, for example, those in the hotel industry. Experts believe that one of the most adequate solutions is to redirect the capital for investment in those sustainable economic sectors that have a significant potential to generate green jobs. These jobs offer the opportunity to address simultaneously two issues, namely, the employment crisis caused by the COVID-19 pandemic and the climate crisis.

At the same time, Romania is committed to transforming the economy into an ecological one with low GHG emissions, the goal stated in the National Recovery and Resilience Plan (NRRP) being to achieve climate neutrality in 2050. In this context, the jobs in certain economic sectors, such as energy production from conventional resources, are seriously affected. To reduce the impact of this transformation on the labor force employed in those areas, increased investment in activities considered as sustainable is the best solution.

In Romania, government policies to support the green economy have been inconsistent and inefficient. The motivation of investors and people as future employees in green jobs must be considered, taking into consideration the conditions of the transition. These conditions concern difficulties regarding the economic efficiency of the new activities, the increasing costs of some products and services, and consumption suffering a shock. If we consider the long-term stakes of the transition to a green economy, the economic and social costs cannot be avoided. Some of the actors in this process find the required sacrifices and risks unacceptable. That is why the economic and social costs of this transition must be distributed so that all those who can play a role in stimulating the growth of the green economy are not discouraged, but motivated to accept the new challenges and to find solutions to overcome the difficulties. This role can only be assumed by governments by promoting appropriate policies for the purpose.

The strength and determination of governments acting in this direction are different, but the complex interdependencies that globalization has generated make each country pay attention to the issues. In this area, too, the speed of each country’s reaction is important, as is the ability to keep up with those at the forefront, including finding and applying original solutions to specific problems. Those who ignore the obvious path towards the green economy, neglect its development potential and do not take into account the negative impact of such behavior on economic relations with other states, will have to make much greater efforts to catch up.

The use of renewable energy sources ensures the stimulation of employment, by generating new green jobs in the sector of “clean” technologies. There is an important influence belonging to the labor force employed in the sector of production of energy from renewable sources for this economic branch to make an important contribution to achieving sustainable growth and an increase in gross domestic product, and also on the health of the living environment, the decrease of pollutant emissions from fossil fuels, as well as the mitigation of global warming. The use of renewable resources for energy production is already an important global goal for more and more countries. The arguments in favor are multiple, the most important considered to be that they are non-polluting and do not affect the health of humans or the planet. Globally, investment in the renewable energy sector is growing sharply and more and more developed countries are investing heavily in this area.

6. Conclusions

This paper sought to provide empirical evidence from Romania on the size of employment in green activities and to create a series of trends over a period of significant change to the Romanian energy sector. By analyzing the structure of renewable energy production in
Romania and green jobs generated by the renewable energy industry, we hope to contribute to a better understanding of the implications of a transition to the green economy on creating green jobs. The methods used to conduct the research were analysis of current data on renewable energy production and employment in this sector to predict employment by subsectors of activity; and forecasting of the structure of the average number of employees in the field of renewable energy, by type of source, using the “Markov Chain Method”.

Along with increased investment flows and increased production capacity, employment in renewable energy production is growing rapidly, and this growth appears as if it will accelerate in the coming years. Green energy forecasts clearly show an increase in this type of energy among total production. In this national context, we estimate that the exploitation of renewable energy resources will generate the stimulation of employment, by generating green jobs in the sector of new “clean” technologies. In order to acquire the necessary skills, the forecast for 2025 on the structure of the labor force employed in the renewable energy production sector, by types of exploited sources, is very useful. Thus, with the help of the Markov chain method, it was forecasted that in 2025, the largest share in the average total number of workers employed in the renewable energy production sector belongs to employees in the field of hydropower (74.68%). The employees in the production of solar energy will represent 14.31% of the total number of workers in the sector of renewable energy production, 5.8% will represent the workers in the production of energy obtained from biomass, while those in wind energy will represent 5.2% of total employees in the green energy sector.

Similar results highlighting the positive correlation between increased investment flows and increased renewable energy production capacity and the growing evolution of the number of green jobs were also recorded by Paşnicu and Ciucă [70], Sulich and Rutkowska [64] and Aceleau et al. [63]. Thus, Paşnicu and Ciucă demonstrate that the trend in the number of green jobs in Romania, for the period 2016–2030, is an ascending one, based on the increase in green acquisitions and expenditures for environmental protection, using data analysis on current labor market developments in Romania and a model of regression analysis between environmental spending and green jobs. These studies highlight the implications of the current reality of increasing green procurement on the labor market in the current context of the transition to a green economy.

According to Bowen et al. [47], which examines the changes in relative demand for certain jobs and the changes in skills needed for certain jobs under the influence of this shift in the United States economy, this transition to green growth is proving to have a significant impact on the structure of the global labor market.

According to Sulich and Rutkowska [64], in the European Union, the environmental goods and services sector (EGSS) is growing faster, in terms of job creation and added value, than the European economy as a whole. The mentioned study reveals an increase in the contribution of this sector to the formation of GDP from 1.5% in 2003 to 2.1% in 2015, and in terms of job creation, the contribution of this sector increased from 1.3% in 2003 to 1.7% in 2015. EGSS has seen an increase in number of jobs, especially in the production of energy from renewable sources, the production of wind and solar power plants and equipment and installations for heating and energy saving.

Recently, the subject of green energy has been a priority for responsible countries, both at European and global level, and it is easy to see the steps they are taking to research and develop the technologies needed to produce clean energy from sources such as wind, solar and biomass. Taking into account the economic benefits, and especially the ecological ones that the energy produced from renewable sources brings, the concern of all countries of supporting, through investment, the development of this economic sector is perfectly justified. At the same time, in addition to these investments at European and global level, a positive impact can also be noticed among consumers. An increasing number of people are interested in green energy, concerned at the same time with the use of more efficient energy supply solutions and with a sustainable future. This concern contributes both to the protection of the environment and to the improvement of our quality of life.
The various policies and programs to promote the green economy aim, in the end, at common goals, which stem from acknowledging the major global risks of environmental degradation, which endanger both the existence of life forms on earth and the risks associated with the depletion of non-renewable resources. Unfortunately, references to the benefits of renewable energy are still perceived in Romania as a cover for the diversion of government support in energy projects that sometimes have an unclear ownership. Multiple educational activities in the social and environmental field are needed to reveal the benefits of renewable energy to change the negative perceptions among Romanian society. A better understanding of other benefits, such as job creation, is therefore of great importance for improving the sector’s performance and increasing public support.

Policy makers can pursue two directions for the development of the green economy: on the one hand, support for green jobs creation, and on the other hand, promoting green growth. The impact on employment is a way for policy makers to assess the effects of sustainable economic development policies.

Policy measures to support green jobs need to include environmental rehabilitation and preservation programs, the promotion of social and green jobs programs, assistance and international standards. Improving the situation of green jobs is important not only from a quantitative point of view—these measures being designed to create jobs—but also from a qualitative point of view, leading to decent work. Other challenges for green jobs concern the opportunity of accessing financial credit to reduce the gap created by access to technology, and gaining access to equipment. Governments need to promote such actions to improve the technical and managerial capacity of potential employees in green jobs, as well as entrepreneurs in the field.

The limits of research
In conducting the study, we were faced with certain limitations that stem mainly from the lack of detailed statistics on the use of green energy sources, as well as green jobs, in the field. Other limitations of the study refer to the lack of unique views on the methods used to detect the link between increased investment flow and increased production capacity and employment in renewable energy production. The analysis and projection of the structure of the average number of employees in the field of renewable energy by type of source took into account only the entities whose object of activity was electricity production; the individuals that have another object of activity to produce energy from renewable sources being eliminated from the list of producers accredited by the National Energy Regulatory Authority (NERA). Thus, the analysis does not include all existing green jobs in the renewable energy sector in Romania, and no data are available on the number of employees dealing with renewable energy production within entities with another object of activity declared to the authorities. At the same time, another limitation of the study on the structure of the human resources employed in the renewable energy sector by type of source used for energy production, refers to the entities for which the tax authorities did not publish data in the annual accounting reports. As a result, the analysis could not take into account the information on the average number of existing employees at the level of these entities.

Further developments
The renewable energy production sector is considered one of the most representative sectors of the green economy in Romania. As a result, the research carried out took into account analysis of the dynamics of the structure of green jobs, on the four types of exploited resources existing at the level of renewable energy production in Romania, in the period 2010–2020, and its forecast for 2025. The analysis showed an increase in the average number of green jobs in wind, solar and biomass production. Given that the analysis was carried out at national level, a possible further development of the research concerns the geographical location of the new green jobs created by the development of new green energy production capacities. Knowing the geographical regions with an important potential to generate green jobs is important for both investors and public authorities to develop appropriate public policies to stimulate growth in the potential to generate green jobs. Our paper analyzes
green jobs only in the field of renewable energy production, but the research can be further developed through an extensive analysis of other economic sectors which create green jobs. The green economy is not a homogeneous and distinct sector of activity because it is found in all sectors, as a component which is continuously developing and diversifying. Its share increases as solutions and opportunities for actions to protect the environment are identified, in order to combat pollution and to replace non-renewable resources.

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