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Sustainable Development and Renewable Energy Policies in the European Union: Transformations and Impacts

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ABSTRACT:
The development of renewable energies in the EU is essential for sustainable development and energy security, having a significant impact on labor markets. Strategies and policies target the EU's objectives and commitments, financial incentives, regulations, innovations, research, in line with labor market opportunities. Reconversion of the workforce and transition to renewable energies are needed, as well as reskilling from traditional industries to green energy sectors. and reducing dependence on fossil energy sources contributes to energy security in the EU. Our proposals emphasize the importance of renewable energies in the reduction of greenhouse gas emissions and the preservation of the environment, with a particular emphasis on the promotion of sustainable development. Ensuring energy security and sustainable development strategies necessitates multilateral cooperation in the development of renewable energies. To analyze the theme, we propose theoretical and practical approaches, correlating sustainable development theory, labor market theory and public policy theory, with practical applications in renewable energy sector strategies and policies and impact on labor markets.

Keywords: renewable energies, labor markets, sustainable development, financial incentives, multilateral security

1. Introduction

The adoption of renewable energies is a crucial element in the European Union's (EU) plan for sustainable development and energy security (Angheluta et al., 2019). The increasing evidence of climate change is driving the military conflict in Ukraine to intensify its efforts in promoting renewable energies in EU countries. These endeavors are not only a constituent of environmental policies, but also a significant catalyst for the alteration of economies and labor markets. The policies and strategies in the realm of renewable energies are designed to attain ecological goals, foster innovation, and promote economic growth (Diaconu et al., 2019). These factors encompass monetary rewards, advantageous regulations, and allocation of resources towards research and development (Rădulescu, Angheluta et al., 2022). Simultaneously, the shift towards green energy necessitates the

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reconfiguration of the labor force, along with the reskilling of workers in conventional sectors (Burlacu, 2018). This alteration presents substantial prospects, as well as difficulties, for labor markets throughout the European Union (Ladaru et al., 2022). Within this framework, Romania, alongside other member states, is obligated to adopt and execute suitable policies to guarantee a just and effective transition. It is essential to promote sustainable development by utilizing renewable energies, as this not only helps to minimize environmental harm (Bodislav et al., 2020), but also contributes to the creation of new and sustainable employment opportunities (Ciobanu et al., 2019). To achieve these goals, it is crucial to have multilateral collaboration and the exchange of best practices among member states.

This paper conducts a bibliographic analysis of the studied theme, highlighting the necessity of incorporating the theories of sustainable development, the labor market, and public policies into the formulation and execution of strategies in this sector. The proposed methodology encompasses an examination of the environmental economy and the impact of digitization on the advancement of renewable energy networks. This holistic approach offers a thorough understanding of how energy policies can facilitate an equitable and environmentally conscious shift towards a sustainable future.

2. Analysis of environmental economics in the European Union

2.1. The evolution of renewable energies in Romania

Romania has placed a high importance on the promotion and utilization of renewable energy sources, creating a suitable legal and organizational structure. The "Strategy for the exploitation of renewable energy resources" (HG 1535/2003) conducted an evaluation and publication of the technical energy potential of renewable sources in 2003. GD 443/2003 implemented Directive 2001/77/EC into national law, with the aim of encouraging the generation of electricity from renewable sources. The renewable energy promotion system was established by GD 1892/2004, subsequently modified by GD 958/2005, which implemented compulsory quotas and the trading of green certificates. The market for green certificates was initially governed by ANRE Order 22/2006. In accordance with Directive 2009/28/EC, Romania has established a goal of achieving a 24% proportion of energy derived from renewable sources in its final gross energy consumption for the year 2020. This indicates a growth of 6.2% compared to the 2005 baseline of 17.8%. The energy strategy for the period 2007-2020, as authorized by GD 1069/2007, set national objectives of achieving a 33% share of electricity from renewable sources by 2010, 35% by 2015, and 38% by 2020. To achieve the goal set for 2020, the Romanian Parliament passed Law no. 220/2008, which enforces obligatory quotas for electricity generated from renewable sources and the exchange of green certificates.

2.2. Evolution the environmental economy

Based on Eurostat estimates, the environmental economy experienced the most significant growth in Slovakia (31%), Germany (16%), and the Czech Republic (13%) among certain EU member states in 2020. However, there was a 13% decrease in Hungary, an 8% decrease in Denmark, and a 5% decrease in Italy. In 2020, the gross added value and employment increased in 10 EU Member States. Lithuania, Malta, and Latvia experienced respective growth rates of 10.0%, 9.3%, and 3.9% in gross value added in 2020 compared to 2019. In 2020, employment in Lithuania decreased by 5.2%, in Malta by 1.1%, and in Latvia by 0.2%. In 2020, Austria experienced a 4.1% decrease in gross value added, while France saw a 3.0% decrease. Additionally, Austria witnessed a 1.4% increase in employment in the environmental economy, while France experienced a slightly higher increase of 1.7%.

In 2023, the EU experienced a significant change due to the rapid transition away from fossil fuels. This resulted in a 19% reduction (-209 TWh) in emissions from coal, gas, and electricity. On the other hand, renewable sources experienced a significant growth of 44%, surpassing the expected increase of 40%. In 2023, wind power and solar power have emerged as renewable sources of electricity generation, accounting for 27% of the total electricity production in the EU. This represents a significant growth in their annual capacities. In 2023, the capacity of wind power surpassed that of gas for the first time. There was a decrease in the production of coal and gas, with coal production experiencing a decline of 26% (-116 TWh) to reach its lowest level ever recorded at 333 TWh. This accounted for 12% of the EU's electricity mix in 2023. The decrease in coal production by half, from 2016 to 2023, amounting to -327 TWh, can be attributed to the corresponding increase in wind and solar production, which has risen by +354 TWh. The production of gas experienced a 15% decline, equivalent to a decrease of 82 TWh, from its initial value of 452 TWh. This reduction is the most significant observed since 1990. In 2023, the EU energy sector experienced a significant reduction in emissions, with a decrease of 19% (-157 million tonnes of CO2 equivalent carbon). This decline, which was the largest annual decrease, was primarily influenced by the Covid-19 pandemic. The energy sector experienced a decrease in emissions of 46% compared to the highest recorded figure in 2007.

Wind energy is notable for surpassing gas consumption, which experienced a remarkable annual growth of 55 TWh (+13%) in 2023. In 2023, wind and solar energy accounted for over a quarter (27%) of the electricity generated in the EU, showing an increase from the previous year's figure of 23% in 2022. Renewable energies accounted for an unprecedented 44% of the EU's energy sources, surpassing the 40% mark for the first time in history. The total renewable energy generated from both wind and solar sources increased by 90 terawatt-hours (TWh), with a combined installed capacity of 73 gigawatts (GW). In 2023, solar energy experienced a growth of 56 GW, which is an increase from the 41 GW growth in 2022 (+37%). However, the annual growth in 2023 was lower than that of 2022, with an increase of 36 TWh compared to the 48 TWh increase in 2022. The Power EU plan aims to achieve a renewable energy generation capacity of 72% by 2030, which is an increase from the current capacity of 44% in 2023. The proportion of wind and solar energy is projected to rise from 27% in 2023 to 55% in 2030. Solar energy in the EU has experienced a 9.1% growth, resulting in an additional 246 TWh of electricity generated in 2023. By 2050, wind energy will contribute to approximately 70% of the global electricity supply, making it a significant component of the future electricity system. In 2023, Germany ranked first among EU countries in solar energy production, generating 62 TWh, which accounts for a quarter of the total solar energy produced by the EU. Spain ranks second with an electricity consumption of 45 TWh, followed by Italy with 31 TWh, and France with 23 TWh. Greece had the largest proportion of solar energy in its electricity mix, accounting for 19%. Hungary followed closely with 18%, while Spain had 17%. The average for the European Union was 9.1%..

2.3. Analysis of renewable energies

Table 2. Total renewable energy

Cap(MW)	2014	2016	2018	2020	2022	2023
World	1700 116	2 016 555	2 362 540	2 822 931	3 396 323	3 869 705
Europe	439 951	488 676	537 489	609 130	715 542	786 788
EU	352 565	387 892	423 192	479 589	575 334	641 478
Romania	11 152	11 162	11 169	11 121	11 580	11 763

Source: IRENA (2024)

Upon analyzing the data presented in table 2, it is evident that there has been a substantial global increase in total renewable energy capacity from 2014 to 2023. This increase is observed not only worldwide, but also specifically in Europe, the European Union, and Romania. On a global scale, the overall capacity of renewable energy has grown from 1,700,116 MW in 2014 to 3,869,705 MW in 2023, representing a remarkable increase of more than 127% over a period of nine years. The sustained expansion indicates a significant commitment and enthusiasm towards renewable energy, in line with worldwide endeavours to address climate change and diminish reliance on fossil fuels. The renewable energy capacity in Romania experienced a slight increase from 11,152 MW in 2014 to 11,763 MW in 2023, representing a growth of approximately 5.5%. The growth in renewable energy projects in this region is relatively small when compared to global and European trends. This can be attributed to several factors, including challenges, legislative barriers, inadequate funding, and limited infrastructure for the widespread implementation of renewable energy projects.

Table 3. Evolution of hydropower capacity in the period 2014 – 2023

Cap(MW)	2014	2016	2018	2020	2022	2023
World	1067 334	1130041	1173728	1212925	1260883	1267903
Europe	183 626	189 296	192253	194 709	197 129	196 858
EU	123 336	126 964	127 973	128 402	130 358	130 074
Romania	6521	6642	6609	6595	6571	6574

Source: IRENA (2024)

Upon analyzing the data presented in Table 3 pertaining to the hydropower capacity between 2014 and 2023, it is evident that there are both instances of growth and periods of no significant change, which vary depending on the geographical region. On a global scale, the overall capacity for hydropower has risen from 1,067,334 MW in 2014 to 1,267,903 MW in 2023, representing a growth of approximately 19% over a span of nine years. The capacity in Europe grew from 183,626 MW in 2014 to 196,858 MW in 2023, indicating a growth rate of approximately 7%. According to data, the capacity within the EU grew from 123,336 MW in 2014 to 130,074 MW in 2023, indicating a modest increase of approximately 5.5%. However, recent years have shown stagnation in this growth. This could be attributed to the preference given to alternative renewable energy sources, such as wind and solar, as well as the stringent environmental regulations that restrict the establishment of new hydropower initiatives. Romania's hydropower capacity experienced a marginal increase, rising from 6,521 MW in 2014 to 6,574 MW in 2023, representing a growth of 0.8%.

Table 4. Evolution of wind energy capacity in the period 2014-2023

Cap(MW)	**2014**	**2016**		**2018**	**2020**	**2022**	**2023**
World	349 418	466 956		563 840	733 719	901 231	1 017 199
Europe	130 198	155 727		181 787	207 896	240 278	257 111
EU	115 661	138 020		157 272	177 145	203 635	218 766
Romania	3 244	3 025		3 032	3 013	3 015	3 087

Source: IRENA (2024)

Upon analyzing the data presented in Table 4 pertaining to the cumulative wind energy capacity between 2014 and 2023, it is evident that there has been substantial growth both globally and regionally. However, in the case of Romania, there has been a relative lack of progress or stagnation. This signifies a surge of nearly 191% within a span of nine years. In Europe, capacity has grown by approximately 97%. Within the European Union, there has been a significant rise of approximately 89%. The European Union (EU), in line with its environmental and energy objectives, has made substantial investments in wind power, playing a significant role in the overall growth of wind capacity in Europe. In Romania, the overall wind energy capacity experienced a small decline, characterized by an initial decrease followed by a minor increase. There was a variation of approximately -4.8% between 2014 and 2016, and a total increase of approximately 1.3% between 2014 and 2023.

Table 5. Onshore wind energy

Cap(MW)	2014	2016	2018	2020	2022	2023
World	340 915	452 599	540 250	699 350	839 263	944 536
Europe	122 212	143 084	163 060	182 069	210 739	224 742
EU	112 178	130 671	146 728	162603	188 026	201 144
Romania	3 244	3025	3 030	3013	3015	3 087u

Source: IRENA (2024)

Upon analyzing the data presented in Table 5, it is evident that there have been substantial increases in the total onshore wind energy capacity globally and regionally during the period of 2014-2023. However, it is worth noting that Romania has experienced a relative lack of growth in this area. On a global scale, the overall capacity of onshore wind power has risen from 340,915 MW in 2014 to 944,536 MW in 2023. This signifies a growth of around 177% within a span of nine years. In Europe, the capacity of onshore wind power has experienced a significant growth of approximately 84%. Onshore wind capacity in the EU has increased by approximately 79%. In Romania, the overall capacity of onshore wind energy experienced a slight decline from 3,244 MW in 2014 to 3,025 MW in 2016. Subsequently, it remained relatively stable, reaching 3,087 MW in 2023. The data shows an initial decline followed by a slight rise, resulting in a net decrease of approximately 6.7% from 2014 to 2016 and a total increase of about 1.3% from 2014 to 2023.

Table 6. Solar energy

Cap(MW)	2014	2016	2018	2020	2022	2023
World	180 759	301 186	492 641	728 405	1 073 136	1 418 969
Europe	91 096	106 175	121 572	142 339	190 928	288 122
EU	83 982	91 901	104 442	138 868	206 075	257 067
Romania	1 203	1 372	1 386	1 394	1 809	1 917

Source: IRENA (2024)

The examination of the data presented in Table 6 pertaining to the cumulative solar energy capacity between 2014 and 2023 demonstrates a substantial global rise, particularly in Europe and the European Union, with Romania also experiencing a noteworthy increase. The global solar power capacity has experienced a significant growth, rising from 180,759 MW in 2014 to 1,418,969 MW in 2023. The solar power capacity within the EU has experienced a substantial growth of around 206%. The rise in numbers is a result of the European Union's endeavors to enhance the adoption of renewable energies by implementing supportive policies, providing subsidies, and making investments in infrastructure. The solar energy capacity in Romania experienced a growth of around 59%.

Table 7. Bioenergy

Cap(MW)	2014	2016	2018	2020	2022	2023
World	90 843	105 675	118 608	133 200	145 896	150 261
Europe	33 297	35 730	40 014	41 861	42 436	42 818
EU	28 515	29 923	32 403	33 805	34 152	34 466
Romania	94	123	141	165	185	185

Source: IRENA (2024)

Upon analyzing the data presented in Table 7 regarding the total bioenergy capacity between 2014 and 2023, it is evident that there are moderate increases observed at both the global and European levels. Additionally, there is a notable and substantial increase in Romania, although it originates from a relatively small starting point. On a global scale, the overall bioenergy capacity has grown by around 66% in a span of nine years. Within the European Union, the bioenergy capacity has grown by around 21%. In Romania, the total bioenergy capacity has increased by approximately 97%.

Table 8. Solid biofuels and renewable waste

Cap(MW)	**2014**	**2016**	**2018**	**2020**	**2022**	**2023**
World	73 344	86 539	97 667	109 761	122 247	126 024
Europe	20 654	22 159	25 256	25 834	26 687	26 924
EU	17 500	18 231	19 633	19 849	20 595	20 783
Romania	79 e	107 e	119 e	136 e	161	161 e

Source: IRENA (2024)

Upon analyzing the data presented in Table 8 pertaining to the aggregate capacity of solid biofuels and renewable waste from 2014 to 2023, a notable surge is observed. The global capacity for renewable solid biofuels and waste increased from 73,344 MW in 2014 to 126,024 MW in 2023. The capacity for renewable solid biofuels and waste within the EU has increased by approximately 19%. The total capacity of solid biofuels and renewable waste in Romania has increased by approximately 104%. While Romania's total capacity for energy sources may be smaller compared to other European countries, the percentage increase is noteworthy, suggesting a growing interest in the development of these energy sources in Romania.

Table 9. Biogas

Cap(MW)	2014	2016	2018	2020	2022	2023
World	15 195	16 853	18 512	20 204	20 815	21 399
Europe	10 845	11 778	12 921	13 341	13 534	13 809
EU	9 218	9 900	10 938	11811	11468	11594
Romania	15	16	22	30	23	23

Source: IRENA (2024)

Upon analyzing the data presented in Table 9 regarding the overall biogas capacity between 2014 and 2023, it is evident that there has been a steady increase in both global and European levels. However, there have been slight variations in the installed capacity. In Romania, there is an initial upward trend observed until 2020, which is then followed by a slight decline and subsequent stabilization.

Tabel 10. Geothermal energy

Cap(MW)	2014	2016	2018	2020	2022	2023
World	11 249	12 173	13 196	14 157	14 653	14 846
Europe	1 503	1507	1617	1627	1637	1637
EU	849	857	876	886	895	895
Romania	0	0	0	0	0	0

Source: IRENA (2024)

Upon analyzing the data presented in Table 10 pertaining to the cumulative geothermal energy capacity from 2014 to 2023, it is evident that there has been a moderate increase in global and European levels. However, it is worth noting that Romania has not made a substantial contribution to this growth. The worldwide geothermal power capacity has grown from 11,249 MW in 2014 to 14,846 MW in 2023, representing a 32% rise. The geothermal energy capacity within the EU experienced a modest increase from 849 MW in 2014 to 895 MW in 2023. According to the data in the table, Romania did not provide any capacity for geothermal energy during the analyzed period. The Energy Strategy, on page 34, identifies a geothermal potential in Romania that can be economically utilized. This potential is found in a large area in the western part of Transylvania, as well as smaller areas in the north of Bucharest, north of Rm. Vâlcea, and around the town of Țăndărea. This can be ascribed either to the dearth of exploitable geothermal resources in the nation or to the insufficient investment or interest in their utilization.

3. Bibliographic study

Bowen (2012) contends that the potential adverse impacts of green growth policies on labor productivity and employment costs are often disregarded. He proposes that the shift towards sustainable economic growth and the generation of employment can go hand in hand, despite the existence of obstacles, especially for nations that have based their plans for industrial advancement on the use of low-cost carbon-based energy. Piwowarska (2023) examines the consequences of phasing out fossil fuels and promoting renewable energy sources on the worldwide workforce, highlighting substantial implications for the economies of various nations, installation manufacturers, and environmental conservation. Lehr et al. (2012) examine the impact of significant investments in renewable energy on the labor market. They specifically focus on Germany's expanding renewable energy sector and emphasize the importance of using model-based analyses to validate the economic effects of the growing use of renewable technologies. Bozkurt and Destek (2015) analyze the correlation between economic growth, renewable energy consumption, gross fixed capital, and total labor force in selected OECD countries from 1980 to 2012. They find that renewable energy consumption has a positive impact on economic growth, particularly in more developed countries. In their study, Nicolli and Vona (2019) examine the impact of energy liberalization, in relation to other factors, on the implementation of renewable energy policies in OECD countries. Their findings indicate that energy liberalization leads to a rise in public endorsement of renewable energy.

In their study, Wasiuta (2018) examines the possible growth paths for the renewable energy sector (RES) in Poland, specifically looking at the impact on employment in electricity generation technologies like wind power plants and solid biomass. Rustico and Sperotti (2012) examine WiRES (Women in Renewable Energy Sector), a project executed by Adapt in conjunction with European partners, with the objective of fostering female involvement in environmentally friendly occupations. In Dell'Anna's (2021) study, the author examines the possibilities of investing in Italy's renewable energy industry using Input-Output analysis. The study emphasizes the positive societal impacts of creating more jobs in an economy that is transitioning to a low-carbon model. Meyer and Sommer (2016) evaluate the hypothesis that the shift towards a low-carbon economy is economically warranted by analyzing the factors that influence employment and conducting scenario assessments to determine the employment impacts of renewable policies. In their study, Clausen and Rudolph (2020) examine the possibility of promoting economic growth in rural regions by implementing decentralized renewable energy systems. They highlight that although this potential has been acknowledged as a goal of energy transitions, it has not been fully realized.

Boromisa et al. (2015) contend that a "green economy" should be established based on "green jobs," which aim to decrease energy usage and minimize environmental harm. However, the precise meaning of "green jobs" is still a subject of debate. Tsangas et al. (2022) emphasize the significance of renewable energy in promoting sustainable development, acknowledging its advantages such as reduced carbon emissions and the generation of employment opportunities. Armeanu et al. (2017) emphasize the significance of energy in driving economic advancement. However, they caution that the escalating energy costs and environmental issues pose a threat to sustainable development. Simionescu et al. (2021) highlight the significance of governance quality in establishing a connection between renewable energy consumption and the reduction of pollution. They suggest that incorporating governance quality in the green and digital economy can effectively contribute to achieving environmental objectives by 2050. Yeo and Oh (2023) examine the overall effects of renewable energy expansion policies in Korea on the economy, with a specific emphasis on the often-neglected consequences of financing mechanisms. According to Naqvi et al. (2022), the long-term impact of renewable energy production in European countries has led to a substantial decrease in unemployment rates. Kwilinski et al. (2023) examine the European Union's objective of achieving carbon neutrality, highlighting the importance of promoting inclusive economic growth by implementing appropriate incentives. Swain et al. (2022) examines the effects of the shift towards renewable energy on employment and non-renewable energy sources in Europe. They evaluate how this transition can potentially contribute to future job creation, production, and reduction of carbon emissions. Trasca et al. (2022) discuss the geothermal energy potential of Romania and emphasize its significance in achieving the renewable energy objectives of the European Union. In Güney's (2021) study, the author examines the impact of renewable energy on GDP and sustainable development. The study suggests that OECD countries should promptly adopt strategies to expand the renewable energy industry in accordance with the Sustainable Development Goals set for 2030.

4. Research methodology

4.1. Theoretical and practical approaches

The comprehensive methodology integrates various theoretical and practical approaches. The intersections between sustainable development theory, labor market theory and public policy theory are analyzed, applying these theories in the specific context of renewable energy policies. Research Objectives: (1) Assess the impact of renewable energy policies on EU labor markets. (2) Identifying opportunities and challenges in retraining and retraining the workforce. (3) Analysis of how reducing dependence on fossil energy sources contributes to energy security and sustainable development. (4) Formulating recommendations for public policies to support the transition to a green and sustainable economy. Research Methods: Literature Analysis. Systematic review of existing literature on renewable energy policies, labor markets and sustainable development. Identifying Gaps: identifying gaps in literature and the need for new research. For the development of strategies and policies in the field of renewable energies, it is necessary:
(1) To evaluate the impact and management of risks oriented towards the analysis of social, economic and environmental effects in the implementation of the proposed strategies and policies, the identification and management of associated risks; (2) Implementation of an effective system for monitoring progress in the promotion of strategies and policies, regular reporting of the results obtained. (3) Facilitating dialogue and collaboration between Romania and other EU member states for the exchange of experience and best practices in the field of renewable energy development; (4) Development of educational programs and public awareness to promote the use of renewable energies, for the involvement of citizens in the transition to a sustainable energy system. It is essential that

this support is flexible and adaptable to changes in the energy field and regularly updated to reflect developments and challenges.

4.2. Systems theory as support in supporting the development of renewable energies.

From the systemic perspective Mele, C., Pels, J., & Polese, F. (2010) who claims that "we must apply a global vision to emphasize its functioning", and which represents a conceptual and methodological framework for understanding and managing the complexity of building the renewable energy market (such as wind energy, photovoltaic energy, hydropower, biomass and geothermal energy) both in Romania and in other European Union countries. Applying this theory can be essential to efficient and sustainable market development.

We have focused only on a few key aspects of the application of systems theory in this context:

(1) Systemic analysis involves the analysis of the renewable energy market as a complex system, consisting of multiple interconnected subsystems (production, distribution, consumption, regulation, etc.) This allows the identification and understanding of the interdependencies and feedback within the energy system.

(2) The integration of Renewable Energy Sources has specific characteristics and challenges. For example: Wind, due to variability in production requires solutions for energy storage and grid flexibility. Photovoltaic, through large-scale integration may require the modernization of the electrical grid infrastructure. Hydropower is a stable source, but environmental impact and water resource management are critical. Biomass - represents a solution for the recovery of waste but requires efficient logistics chains. Geothermal provides constant energy but is geographically limited to certain regions.

(3) Regulation and Policies, requires the creation of a stable and predictable framework for investment, adequate regulation is essential. Support policies such as subsidies and feed-in tariffs are key tools. In the EU, policies are oriented towards achieving the objectives of reducing carbon emissions and increasing the share of renewable energies in the energy mix.

(4) Innovation and Technology. Advanced technologies such as smart grids, energy storage and artificial intelligence solutions for demand and supply management play a crucial role in optimizing the operation of the energy system. In Romania, the adoption of these technologies is under development and can benefit from European funding.

(5) Regional Collaboration and Interconnection. In the EU, the interconnection of electricity networks between countries allows the balancing of production and consumption at a regional level. Romania participates in the common European energy market, benefiting from interconnection with the networks of neighboring countries.

(6) Sustainability and Environmental Impact. An essential aspect of applied systems theory in the renewable energy market is environmental impact assessment and sustainability assurance.

(7) Public Participation and Social Acceptance. The success of the renewable energy market also depends on public acceptance and the active participation of local communities. Education and outreach programs, as well as direct economic benefits to

communities hosting renewable energy projects, can improve public acceptance and support.

4.3. The impact of digitization in the development of renewable energy networks

The process of digitization has a substantial influence on the growth and effectiveness of the network for renewable energy markets, encompassing wind, photovoltaic, hydropower, biomass, and geothermal energy. The adoption of digital technologies is revolutionizing the production, management, and consumption of these energy sources.

Digitization is having a significant impact on this sector in the following ways:

(1) Live Monitoring and Control. Digital technologies facilitate instantaneous monitoring and control of energy production and consumption. SCADA systems are utilized to gather data from production equipment, such as wind turbines and solar panels, to enhance their operation.

(2) Intelligent Power Distribution Networks. Smart grids utilize digital technologies to enhance the dependability and effectiveness of the power grid. They facilitate the optimization of supply and demand, resulting in decreased losses and enhanced grid stability. Smart grids enable the incorporation of fluctuating renewable energy sources like wind and solar power through the utilization of sensors, smart meters, and sophisticated algorithms.

(3) Energy storage and demand management. Digital solutions are used to manage and optimize energy storage technologies, such as lithium-ion batteries. They enable the storage of surplus energy generated during peak periods and its utilization during periods of high demand. Demand response programs utilize digital technologies to modify energy consumption based on the availability of renewable sources, thereby aiding in grid balancing and enhancing energy efficiency.

(4) The application of Data Analysis and Artificial Intelligence (AI) in the field, using Big Data and AI, enables precise predictions of renewable energy production and demand. Artificial intelligence aids in the detection of abnormalities, mitigates equipment malfunctions, prolongs their lifespan, and minimizes operational hazards.

(5) Utilization of Blockchain in Energy Transactions. Blockchain technology enables decentralized and secure energy transactions. It allows small renewable energy producers, like solar panel owners, to directly sell excess energy to consumers, thereby establishing local energy markets.

(6) Blockchain technology guarantees transparency and security in transactions, thereby minimizing the potential for fraudulent activities and ensuring an equitable allocation of energy resources.

(7) Enhanced automation and control of renewable energy systems facilitate the efficient and flexible operation of renewable energy plants. Advanced control technologies, such as adaptive and predictive control, enhance the performance of plant operation in changing conditions.

(8) Digital technologies empower consumers to become prosumers, enabling them to both produce and consume energy while equipping them with the necessary tools to effectively manage their energy production and consumption.

(9) Energy management platforms, aided by mobile applications and IoT devices, enable the monitoring and optimization of energy usage at an individual level, promoting sustainable behavior and reducing consumption.

(10) The merging of energy markets and the coordination of regions. Digital platforms facilitate the merging and organization of energy markets on both domestic and global scales. The transfer of information and energy between different regions and countries plays a crucial role in maximizing the utilization of renewable resources and ensuring energy stability.

(11) Advancement and investigation. Digitization enables the efficient implementation of pilot projects and tests for new technologies and solutions, thereby expediting the integration of innovations in the energy sector.

The Influence of Renewable Energy Strategies and Policies on the Labor Market in Romania and Other European Union Countries

1. The establishment of job opportunities in the construction and installation sector of the wind energy industry will involve a wide range of skilled and unskilled workers, including engineers, technicians, and construction laborers, due to the extensive workforce required for building and installing wind farms. Photovoltaic projects in the solar energy sector require substantial installation of solar panels, resulting in the recruitment of a considerable workforce of installers and electricians.
2. Management and upkeep of equipment. Wind and solar power plants necessitate regular maintenance, resulting in the creation of enduring employment opportunities for maintenance technicians and engineers.
3. Real-time monitoring using digital technologies and systems necessitates the expertise of IT specialists and system engineers.
4. Reeducating the workforce via training and educational initiatives. Designing and implementing training courses and certification programs for emerging technologies in the renewable energy sector. Renewable energy modules are being incorporated into the academic curriculum and professional training programs at universities and training institutions, specifically in undergraduate programs. Master's degree, postgraduate studies, and professional retraining. Additionally, there are technological high schools and post-secondary programs specifically designed to educate technicians in the field of renewable energies.

5. Conclusion

Developing renewable energies has become essential for attaining sustainability goals and mitigating greenhouse gas emissions in the European Union (EU). Strategies and policies in this area have a significant impact on the labor market, generating new jobs and retraining needs for the workforce.

Renewable energy strategies and policies have a profound impact on the labor market in Romania and other EU countries. They not only generate new jobs, but also require retraining and adaptation of the existing workforce. In addition, the development of renewable energies contributes to regional development, economic stability, technological innovation, thus supporting the transition to a sustainable and low-carbon economy. Successful policies from various EU countries can serve as models for Romania, contributing to an efficient and fair energy transition.

Digitization is essential for the development and optimization of renewable energy networks. By integrating digital technologies, the operational efficiency, flexibility, and stability of the energy network are improved. Romania and the EU benefit from these technological advances, which allows them to achieve the goals of energy transition and reduction of carbon emissions, thus contributing to sustainable development and energy security.

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