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Article

Green Jobs in the Energy Sector

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Abstract: This article analyzes Green Jobs (GJs) in the energy sector. GJs are naturally created in the processes related to the implementation of the Sustainable Development Goals (SDGs); this is especially visible in the 7th and 8th SDGs. There is currently a green transition from fossil fuels to renewable energy sources in the energy sector, and this mainly technological change also influences GJ creation. Despite this, there is a research gap related to green self-employment and GJ definitions. The goal of this paper is to explore the scientific literature collected from the Scopus database using a qualitative approach to present areas and keywords related to GJs in the energy sector. The adopted method is a Structured Literature Review (SLR), with the original query Q1. The retrieved data results of the SLR method were analyzed in the form of bibliometric maps of co-occurring keywords generated by the VOSviewer software, together with tables showing clusters of keyword features. As a result, the pivotal keywords and their clusters were identified. In this study, the most important scientific areas of GJ research in the energy sector were also indicated. This paper presents the current state of knowledge and the evolution of the subject of GJs in the energy sector, which can be useful for both researchers and practitioners. In the last section of this paper, possible new directions of future studies on the subject of GJ creation in the energy sector are identified. The limitations of this research and its practical implications are also addressed.

Keywords: green economy; green jobs; green self-employment; green transition; energy sector; sustainable development

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1. Introduction

The energy sector [1] occupies a strategic role in the functioning of modern economies [2,3]. Access to energy resources and the quality and reliability of the energy system [4,5] are important [6,7], not only for the possibility of the development of individual sectors of the economy [8,9] but also for how it affects the quality of life of individuals or households [10,11]. Thus, it can even be pointed out that the energy sector [12] is 'the lifeblood' of economic development [13,14]. There are numerous ongoing scientific debates related to the further development of the energy sector [15,16], including such topics as the adopted development strategies [4,12,17], the supply chain in the energy sector [18,19], the types of resources [20,21] used in the process of electricity production [1,22], or the investments undertaken aimed at broadly understood energy security [20,23,24] and prevention of so-called 'blackouts' [25,26]. At the same time, these studies note that it is increasingly necessary to transform the energy sector [27,28]. Despite numerous research subjects being undertaken in scientific publications, the creation of Green Jobs (GJs), green self-employment, or prosumer market development in this economic sector are less discussed topics [29,30].

Minimizing [31,32] and ultimately eliminating [5,33] non-renewable energy sources in favor of renewable energy sources in the operation of individual economies is becoming the goal of an increasing number of countries [34,35], or their communities, as exemplified by the European Union [31–33,36]. Researchers of the subject point out that this type of transformation of the energy sector can be called a green transformation [37–39], as it contributes to the decarbonization of the economy [40], and thus brings it closer to sustainable development in socio-economic life. Decarbonization of the energy sector is a rather complex process [41,42] that poses a challenge to all socio-economic players: policymakers [43,44], consumers [45,46], and businesses [47,48]. One important challenge is that during the transformation of the energy sector, the aim is to minimize, or eliminate, the possible negative consequences of this process of changes for both households [49] and businesses [50]. Hence, the process should not be carried out on an ad hoc basis, and appropriate strategies should be developed and implemented in the energy sector [12,51]. The framework for just such policy was created by the United Nations in the form of the SDGs, which were created in an intertwined and complemented form; however, the 7th and 8th SDGs are the ones most related to the subject of GJs in the energy sector. The 7th SDGs aims to "ensure access to affordable, reliable, sustainable and modern energy for all" [52], while 8th SDGs aims to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" [53,54]. Each of the SDGs has its agenda, targets, and practical pieces of advice to support global efforts toward sustainability, and they inspire researchers to study GJs in the energy sector.

Among the positive effects of the green transformation of the energy sector, some of the researchers draw attention to the creation of so-called GJs [29,55,56]. In light of the increasing number of scientific considerations, a single, universally valid definition of GJs has still not been agreed upon. In addition, one can see the use on the part of researchers of various forms of nomenclature for GJs [29,57], e.g., green collars [58], green employment [59,60], and environmental jobs [61], which poses an additional challenge on the part of researchers of the subject who wish to explore the issue of such specific jobs.

The European Commission defines GJs as covering all jobs that depend on the environment or are created, substituted, or redefined (in terms of skill sets, work methods, profiles greened, etc.) in the transition process toward a green economy [62]. In turn, UNEP studies define GJs as "work in agricultural, manufacturing, research and development, administrative, and service activities that contribute substantially to preserving or restoring environmental quality" [63,64]. The multiplicity of research approaches and created definitions of GJs [65,66] makes it significantly difficult, and in many cases impossible, to compare the results of quantitative studies conducted by different researchers. However, these analyses can be compared with each other in qualitative research in the context of selected sectors of the economy. On a sectoral basis, it is important to note the scientific discourse undertaken in the context of green job creation in the energy sector [67–69]. Hence, the purpose of the research undertaken and described in this article was to analyze the scientific literature collected in the Scopus database from the point of view of an area-based discussion of the issue of GJs in the energy sector. The considerations undertaken in this study are additionally aimed at indicating future directions of research on the issue of GJs in the energy sector [70]. The research gap identified in this study proves that GJs' relation to self-employment issues is currently insufficiently addressed or even ignored in research, and may lead to unintended cognitive errors and inclinations. Thus, the authors aim, through this study, to contribute to the scientific discourse on the issue of the emergence and importance of GJs in the energy sector. The goal of this paper is to explore the scientific literature collected in the Scopus database with a qualitative approach to present areas and keywords [12] related to GJs in the energy sector and how to address any indicated research gaps in the future

Following the logic adopted by the authors for the presentation of the undertaken problem of GJs [29,71] in the energy sector, the article is divided into five interrelated sections [1]. After presenting in the first section the research problem undertaken, which was described based on a review of the literature on the subject [29,72], the second section presents the methodology of the research undertaken. The third section focuses on the description of the research results obtained. The fourth section presents a discussion, which is followed by the conclusions in the last section. Additionally, the paper presents the future research directions on the issue of GJs in the energy sector.

2. Materials and Methods

The research presented in this scientific paper was projected in the six stages presented in Figure 1. The first stage was problem formulation based on the literature review. The scientific database explored in this study was the Scopus collection. The Scopus database was selected (Figure 1, stage II) due to its comprehensiveness of content; it is widely considered a reliable source of knowledge among scientists [73]. Scopus-based bibliometric research in the energy sector has been carried out by many researchers [74–76]. The argument in favor of choosing the Scopus database is the restrictiveness of the content indexed in this scientific database based on Scopus's strict quality and ethics selection criteria [77]. The choice of a scientific database determines the results obtained, as highlighted by other researchers [78–80]. The research procedure is presented in Figure 1 in detail. This procedure reflects the SLR variation method [1,81] to analyze GJs in the energy sector [1,29] and present areas and keywords related to GJs in the energy sector (Figure 1, stage III).

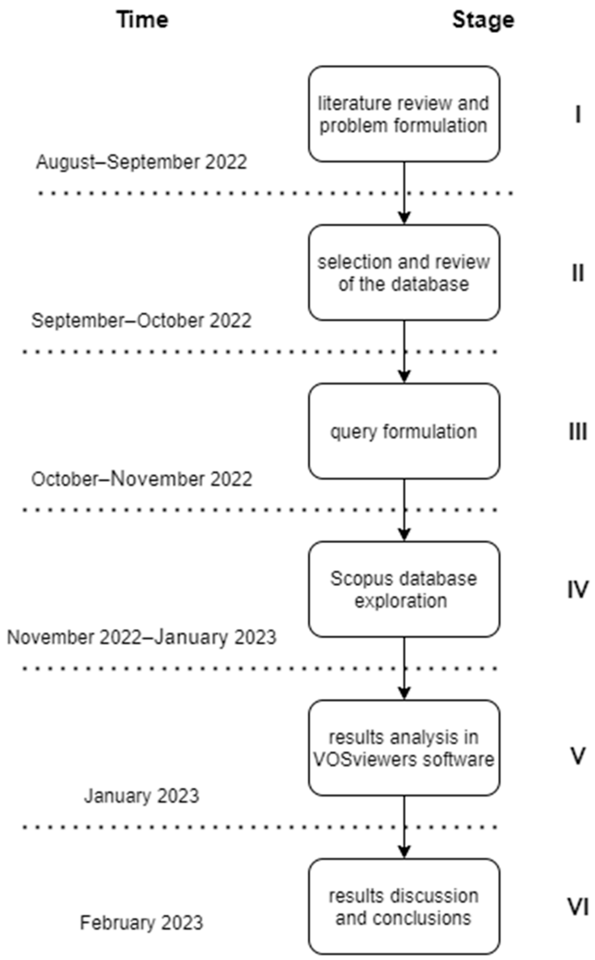

Figure 1. Research procedure stages and timeline. Source: Authors' elaboration.

In this study, there are multiple selected search criteria established in the Scopus database online review, as presented in Table 1 and Figure 1, stage IV. Similarly to the many studies based on bibliometric analysis [76,82], in this research an initial pre-selection of publications was performed based on the content of abstracts [44,74,83]. This initial pre-selection ensured that all 137 analyzed publications were relevant to the topic of GJs in the energy sector [82,84].

There are other fields on the online website that were not applied in the research procedure. In Table 1, the occurrences are indicated in parentheses, after each of the document types from the Scopus collection. Next to the energy subject area, the same publications are also indexed in the other scientific fields presented in Scopus (environmental science; social sciences; engineering; computer science; business, management, and accounting; mathematics; earth and planetary sciences; agricultural and biological sciences; medicine; chemical engineering). This interrelation of subjects proves the interdisciplinarity of GJs in the energy sector.

Table 1. Search Criteria for the IV stage of the performed research.

Criteria	Details
Database	Scopus
Search area	Article title *, Abstract, Keywords
Topics	Green jobs and their alternative names or synonyms
Time span	1995–2022
Subject area	Energy (137)
Document type	Articles (90), Conference papers (17), Books (3), Book Chapters (6), Reviews (13), Notes (3), Short surveys (3), Editorials (1), Letter (1)
Language	Any language; English (136) and Polish (1)
Publication stage	Final (137)

* Each publication title is indexed in the Scopus database. Source: Authors' elaboration.

In Table 1, there are multiple document types, not only articles. The Scopus collection consists [1,29] of peer-reviewed articles, conference proceedings, book chapters, etc. In this collection, there were 137 publications indexed, distinguished, and analyzed based on Query 1 syntax (symbol Q1 in Table 2). In this study, the Q1 syntax was proposed on the basis of previous research results, which used the synonyms and alternative names of GJs [29,66]. The period (1995–2022) indicated in Table 1 is a result of database exploration with Q1, which presented the first publication in 1995, and 2022 is the last year of the final publication stage indexed in Scopus. The download of the Q1 results was performed on 18 January 2023 due to the indexation period and to ensure the completeness of the dataset (Figure 1, stage IV).

The syntax of Q1 in Table 2 is dedicated to searching the Scopus database collection results among titles of indexed publications, their abstracts, and keywords. This is indicated by the very first part of Q1, TITLE-ABS-KEY, before the parentheses opening. Inside Q1 there are alternative names and variants of the GJs placed in the braces (Table 2). Additionally, next to the searched keywords are the specific and unspecific operators used. The specific operators are denoted by single quotation marks, while the unspecific operators are denoted by asterisk symbols. The used operators in the Q1 syntax are OR and AND operators, used as conjunctions to combine or exclude keywords in a search, resulting in more focused and productive results [77,85]. In Q1, a limitation to the energy subject area is indicated, placed in separate parentheses (LIMIT-TO (SUBJAREA, "ENER")).

Table 2. Search Query syntax details. Each publication title is indexed in the Scopus database. Asterisk is a Boolean operator in this query.

Symbol	Query Syntax	No. Results (18 January 2023)
Q1	TITLE-ABS-KEY (({green job} OR {green jobs} OR {*green job*} OR {green-jobs} OR {'green' job} OR {'green' jobs} OR {'green job'} OR {'green jobs'}) OR ({green collar} {green collars} OR {*green collar*} OR {green-collar} OR {'green-collar'} OR {'green collar'} OR {green employment} OR {*green	137

employment*} OR {green employments}) OR ({environmental job} OR {environmental jobs} OR {*environmental job*} OR {'environmental job'} OR {environm* employment) OR ({sustainab* job} OR {sustainab* employment} OR {environm* employment})) AND (LIMIT-TO (SUBJAREA, "ENER"))

Source: Authors' elaboration.

The results obtained from Q1 were downloaded as a file in .csv format and, during the export procedure [1], all fields on the publication were selected [29]. Further analyses were carried out on the collected data in the VOSviewer software, and the results are presented in graphical forms as bibliometric maps. The VOSviewer (version 1.6.18; Centre for Science and Technology Studies, Leiden University: Leiden, The Netherlands) was used to explore the data obtained in the Q1. The generated maps were visualizations of the network, overlay, and density of items and clusters, respectively. VOSviewer is a software tool for creating maps on network data for visualizing and exploring these maps [86,87]. To ensure the reproducibility of this research, the official VOSviewer manual version 1.6.18 [88] was used as a guide for the preparation and description of the result.

VOSviewer presents results in the form of networks. A network is a set of items and links between keywords (items) [86–88]. Items are grouped into clusters (subnetworks), automatically presented in color. In VOSviewer, clusters are non-overlapping [89]. This means that keywords can belong to only one cluster. In this study, clusters are labeled by numbers and colors. The zoom and scroll functions of the VOSviewer software were used to explore each generated map in full detail [87,90], and screenshots of this analysis are also presented in the results section of this study. The default setting of the other variables important for the graphical representation of the results, such as the scale, weights, or scores, was used, and if there was a change of the single element it is described in detail, together with the results.

This research has its limitations because the choice of the number of co-occurrences determine the result obtained in its graphical presentation and bibliometric map clarity [1,91]. Therefore, a minimum number of five keyword co-occurrences was set for each bibliometric map [29,88].

3. Results

In this research, there were 137 publications from the years 1995–2022 analyzed. There were 98 cited publications that were at least cited once (Figure 2). This result was generated on 18 January 2023, as presented in Table 2 and Figure 1, stages IV and V.

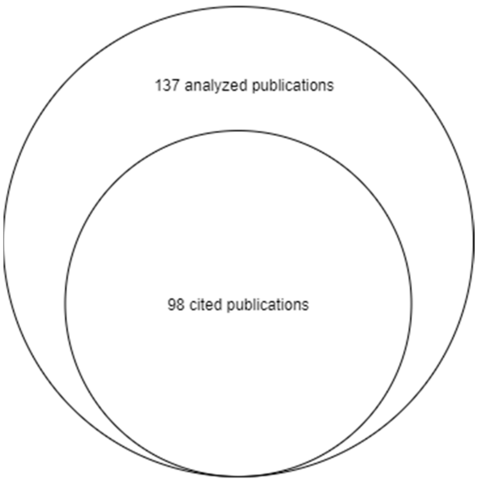

Figure 2. Cited publications on the background of the analyzed indexed in Scopus works. Source: Authors' elaboration.

VOSviewer is a software tool for creating maps [87] based on the data presenting the keyword or terms indexed in the Scopus database [88]. Figure 3 is a bibliometric map full counting method of indexed keyword co-occurrences [1], indexed in Scopus and distinguished by Q1 [29]. In this method, 839 keywords were identified, among them, 40 keywords met the threshold of five co-occurrences. Among those results, keywords referring to the countries, organizations, and continents were excluded from the proposed keywords list in the separate pop-up window, and in total, only four keywords were deselected [83,88]. Finally, there are 36 keywords collected in four clusters automatically colored and identified by the VOSviewer software. Figure 3 presents the keywords most often used in the scientific publications dedicated to GJs [71,72] in the energy sector, as explored by the Q1 syntax.

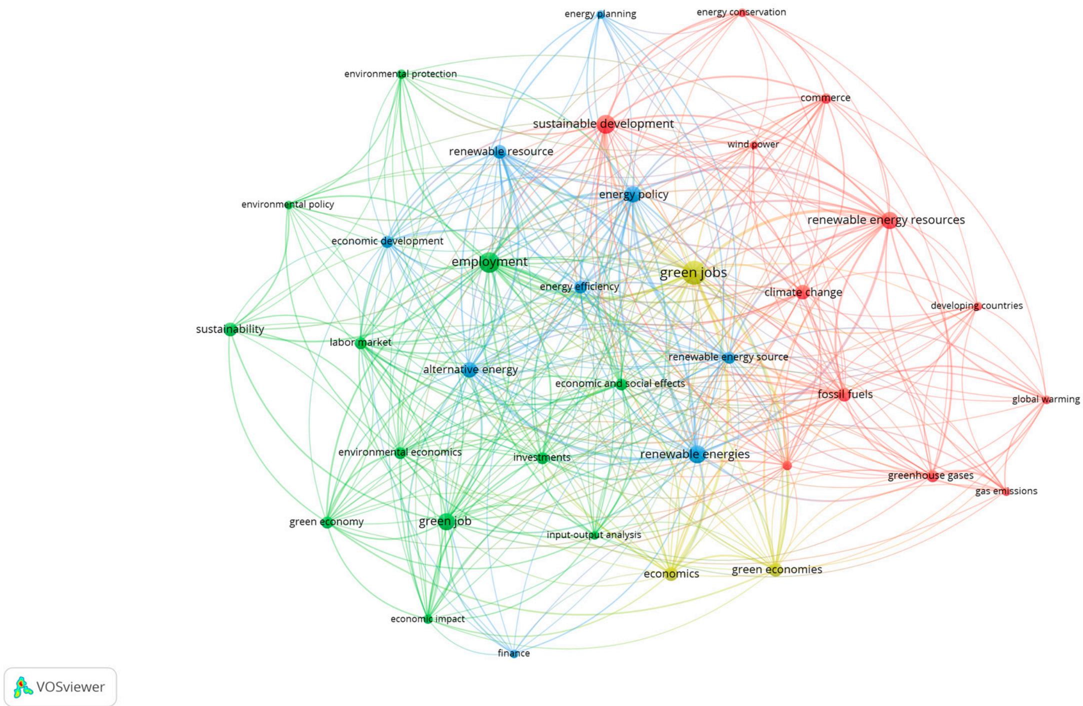

Figure 3. Indexed keyword co-occurrences in the full counting method of Q1 results. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

In Figure 3, there are four subnetworks of the bibliometric map presenting the subject of GJs [29] in the energy sector visible. In this bibliometric map, there are keywords presented as nodes [12]. Between these keywords, there are lines that represent the connections and publications in which those co-occurring keywords were used. Among all the nodes, the biggest keywords, distinguished by size, are "green jobs", "employment", and "sustainable development". The biggest nodes are placed in the center of Figure 3, which also represents the biggest density of the edges. The keywords distinguished automatically in colors are thematically related. The red and blue clusters are connected to the energy sector transformation, while green and yellow are more related to economics, finance, and management.

There are four clusters presented in Table 3, corresponding to Figure 3. Two of the most numerous clusters are red and green. The red cluster consists of 12 elements, as well as the green subnetwork. The third, blue, cluster has nine items, and the least numerous has only three keywords (Table 3). The items explored in this research are terms or keywords represented by the nodes of the network. Between those keywords are links or connections represented by the edges [88]. The edges "are co-occurrence links between terms" [88]. Each type of map consists of only one type of link.

Table 3. Clusters of keyword co-occurrences visible in Figure 3.

Cluster	Color	Keywords
1	Red	climate change (13), commerce (13), developing countries (5), energy conservation (5), environmental impact (6), fossil fuels (11), gas emissions (5), global warming (5), greenhouse gases (9), renewable energy resource (18), sustainable development (22), wind power (5)
2	Green	economic and social effects (9), economic impact (6), employment (25), environmental economics (9), environmental policy (5), environmental protection (6), green economy (9), green job (18), input-output analysis (5), investments (9), labor market (9), sustainability (11)
3	Blue	alternative energy (14), economic development (9), energy efficiency (11), energy planning (5), energy policy (16), finance (5), renewable energies (20), renewable energy source (9), renewable resource (11)
4	Yellow	economics (12), green economies (11), green jobs (33)

Source: Authors' elaboration.

The order of the listed keywords in Table 3, in each row, is alphabetical and is a result of the VOSviewer software calculations. The number of occurrences for each keyword is indicated in parentheses, after each keyword.

The keywords presented in Table 3 are partially related to the energy sector transformation, although the "energy sector" or "energy transformation" keywords have not been disguised by the VOSviewer software.

Based on Figure 3 and the results from Q1, Figures 4–6 have been proposed. Figure 4 is an overlay of the keywords in the years 2015–2021, which is a narrower period of GJs in the energy sector [29] subject evolution than in the general search, 1995–2022. The color bar placed in the bottom right corner of the visualization indicates how scores are mapped to colors [92]. The overlay visualization is identical [87,88] to the network visualization (Figure 3). This is the result of the VOSviewer software and the method of full counting of indexed keywords, which met the threshold of five co-occurrences [1,89]. This overlay analysis presents, in darker colors, the oldest keywords related to the subject of GJs in the energy sector, while the lighter colors present relatively new and fresh keywords. The presented items in Figure 4 have scores, and the color of each item is determined by the score of the item [87,90], where, by default, colors range from blue (lowest score) to green and yellow (highest score) [88,89]. The keywords highlighted in yellow are located on the periphery of the overlay map (Figure 4). The darker ones are in the center. Those yellow color keywords are "green job", "green economy", "finance", "input–output analysis", and "developing countries". This indicates the strong relationship between the energy sector and the subject of GJs to green economy development. In the over-visualization generated by the VOSviewer software (Figure 4), score attributes are considered. Score attributes are not considered in the network visualization (Figure 3) and the density visualizations (Figures 4 and 5).

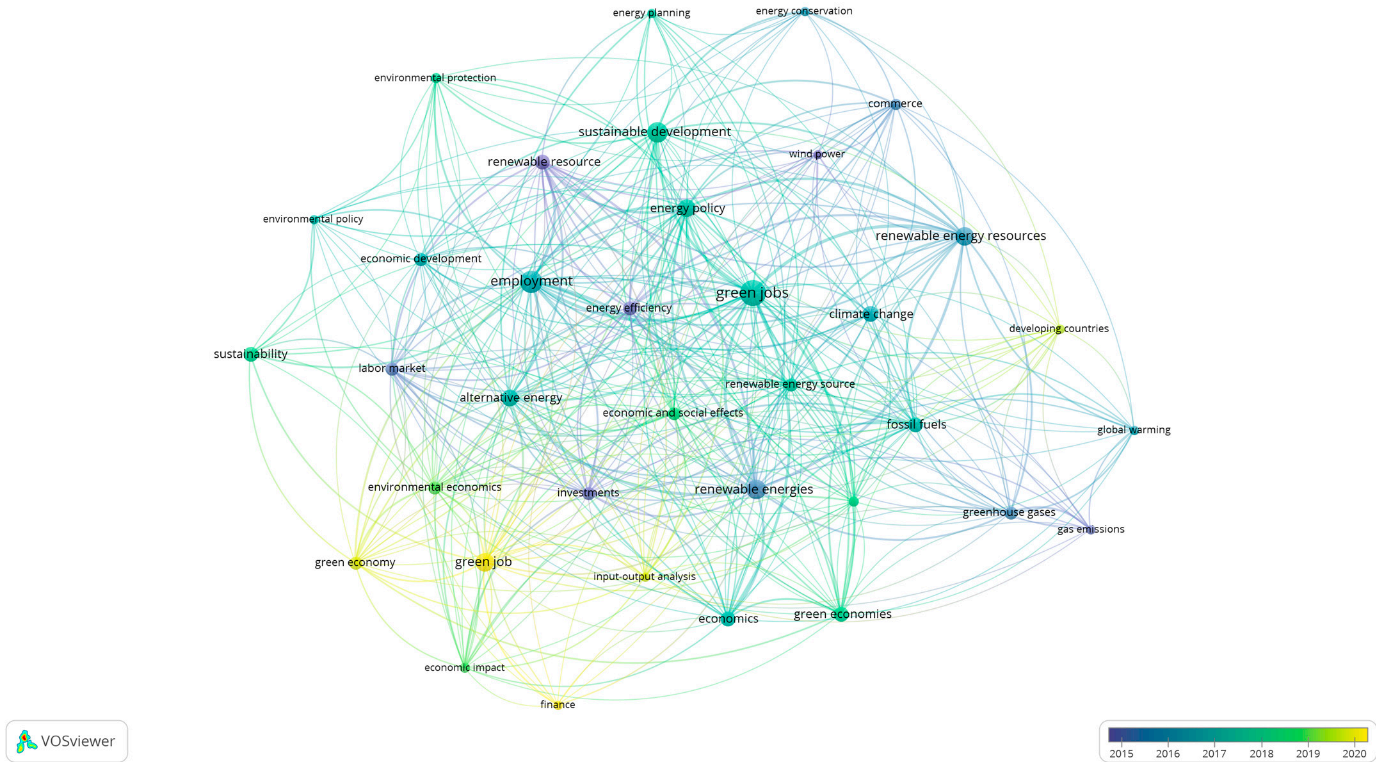

Figure 4. Overlay map of the indexed keyword co-occurrences. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

To check the strength of the presented keywords in Figure 3, the density visualization was proposed in Figure 5. There, the three most often used keywords (22 and more occurrences in Table 3) are presented on the blue background in Figure 5. Those keywords create the centrally located triangle, and those are "green jobs" (33 occurrences), employment (25), and sustainable development (22). There are also other keywords with a significant number of occurrences; however, they are strongly related to the indicated three clusters and leading keywords. Therefore, the weight of the keyword indicates its importance. In the visualization of the map presented in Figure 5, keywords with a higher weight are shown more prominently than items with a lower weight [87,88].

Density visualization can be performed in two variants, as presented in Figures 5 and 6. The first of them is the item density visualization, followed by the cluster density visualization [87,88]. The keyword density visualization was generated from the VOSviewer by the radio button on the right side in the options panel. In the item density visualization (Figure 5), keywords are represented by their label in a similar way as in the network visualization. Each point in Figure 5 has a color that indicates the density of keywords at that point. By default, colors range from blue to green to yellow [87,88]. The larger the number of items in the neighborhood of a point, the higher the weights of the neighboring items [87,88]. The closer the color of the point is to yellow, the higher the weights of the neighboring keywords [87,88]. There is a concentration of the higher-density keywords in the center of Figure 5.

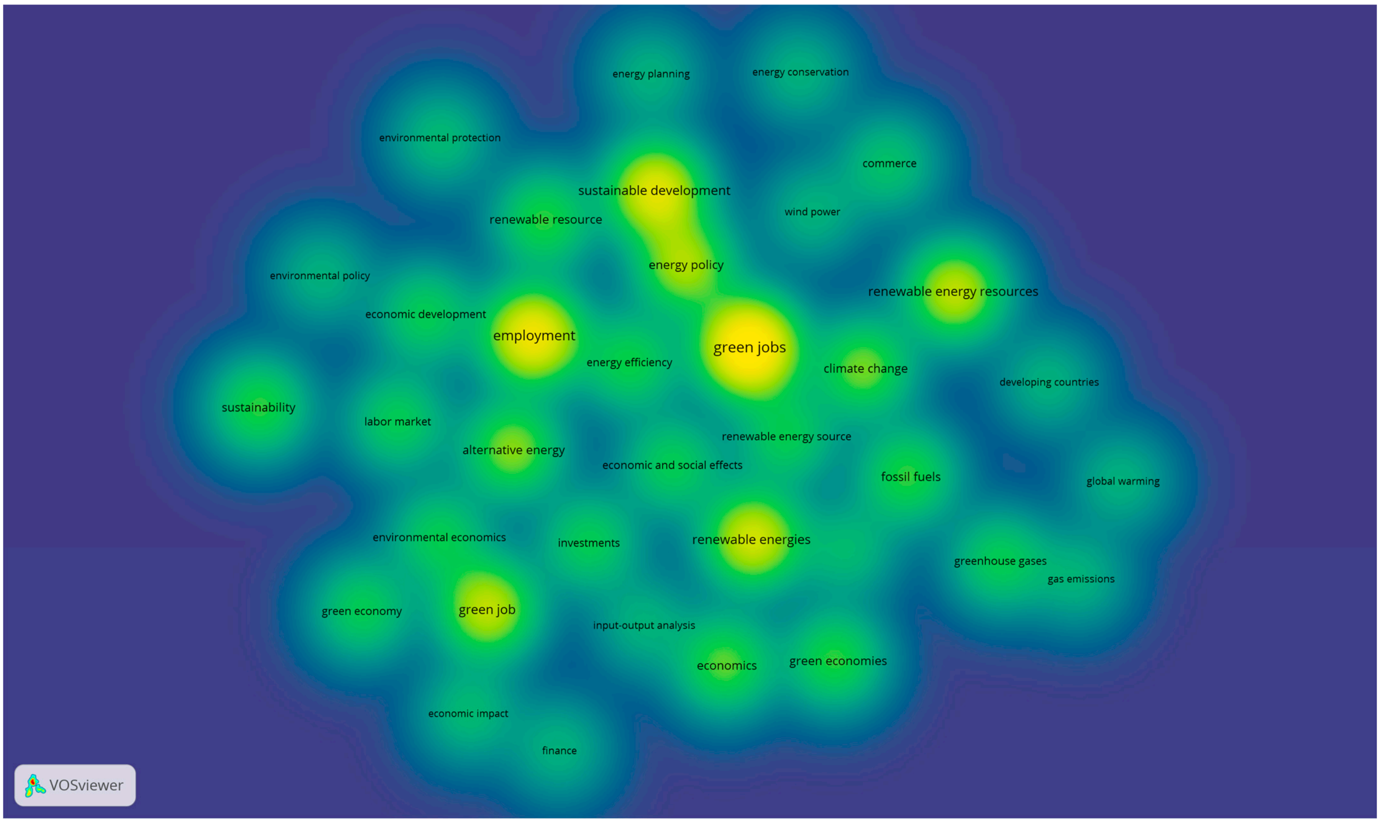

Figure 5. Item density visualization. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

As presented in Figure 5, most significant keywords do not always belong to the most numerous clusters. However, the "green jobs" term is part of the yellow, smallest subnetwork of the general network visualization (Table 3). The keyword assignment automatically distinguished by VOSviewer clusters allowed us to continue the analysis in the form of the cluster analysis.

To check the cluster density, this option in the VOSviewer software was selected, and Figure 6 was generated. The presented cluster density visualization is similar to the item density visualization (Figure 5), except that the density of items is displayed separately for each cluster of items [87,88]. In the presented data in Figure 6, cluster density visualization, the color of a point in the visualization is obtained by mixing the colors of different clusters [87,88]. The blue cluster, dedicated to the technical keywords and energy sector, complements the other clusters. The colors used automatically in the software are the same as those presented in Figure 3. In this step, the results of the subnetworks oriented around the indicated keywords "green jobs", "employment", and "sustainable development" are presented on the background of the whole network (Figure 6). The weight given to the color of a certain cluster is determined by the number of items belonging to that cluster in the neighborhood of the point [86,87]. As in the item density visualization, the weight of a keyword is also taken into account [88].

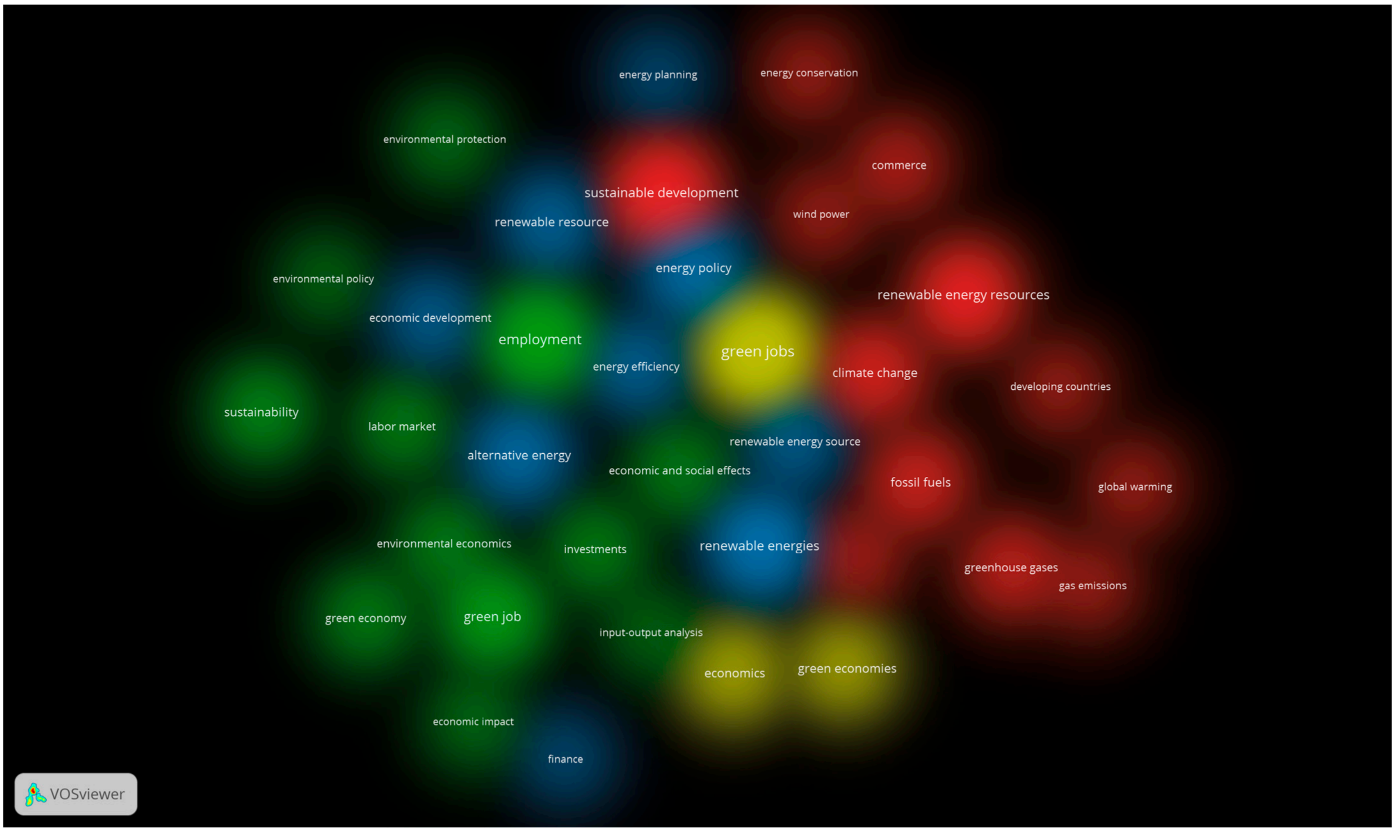

Figure 6. Cluster density visualization. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

Among the presented results, the strength of the connections between the keywords presented in the network visualization was explored. Between any pair of items, there can be more than one link [87,93], and each has a strength, represented by a positive numerical value [88,90], which can be changed by the user in the user interface [89]. Among all of the keywords presented in Figure 3, all link strengths equal to or bigger than five have been presented in Figure 7. This strength option was selected in a panel in the VOSviewer software. The higher the value link strength, the higher the number [94]. The presented colors are the same as in Figure 3 and have not been changed.

The links presented in Figure 7 and total link strength attributes indicate, respectively [94], the number of links of an item with other items, and the total strength of the links of an item with other items [88,94].

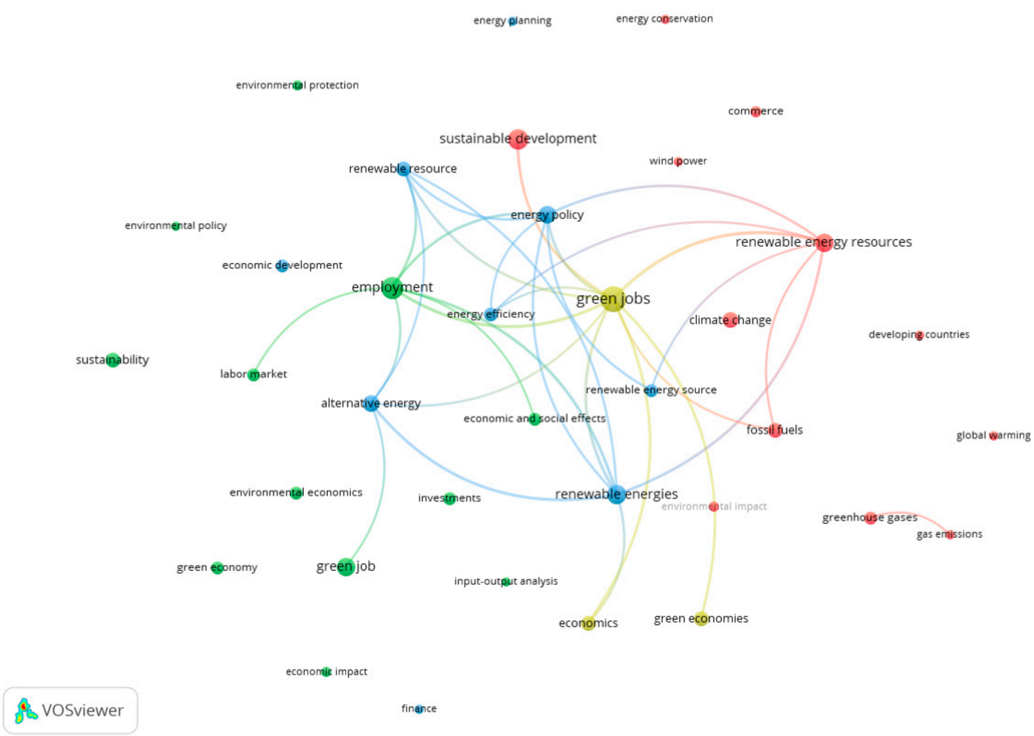

Figure 7. Keywords with a total link strength of five or more. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

Figure 7 presents at least two keywords used five or more times in a single publication (edge of graph). In the case of co-occurrence links, the strength of a link indicates the number of publications [90,95] in which two terms occur together [86,87]. In Figure 7, after total link strength counting, the 18 keywords were connected by indicated edges. There is a keyword diad of "gas emissions" and "greenhouse gases" separated from the main subnetwork.

There are two standard weight attributes, referred to as the links attribute and the total link strength attribute. For a given item, the links and total link strength attributes indicate, respectively, the number of links of an item with other items and the total strength of the links of an item with other items.

Among the obtained results of the network analysis (presented in Figure 3), the significant keywords' relations with other keywords, such as "green job" (Figure 8), "green jobs" (Figure 9), and "employment" (Figure 10) were explored. Figures 8–10 are the results of the screenshots of the situations when the mouse pointer is moved over a keyword in the main panel of VOSviewer where network visualization is generated. The presented keyword dynamic network analysis in Figure 8 presents the subnetwork of the related keywords to the "green job" item. This specific keyword is a grammatical variant of "green jobs"; this is the second most numerous co-occurring item in the green cluster after "employment" (Table 3). The "green job" keyword is also an element of Q1 used to explore the Scopus database. This item has 25 links to other keywords, with a total link strength equal to 49, and has 18 co-occurrences in the explored results from the Scopus database [12].

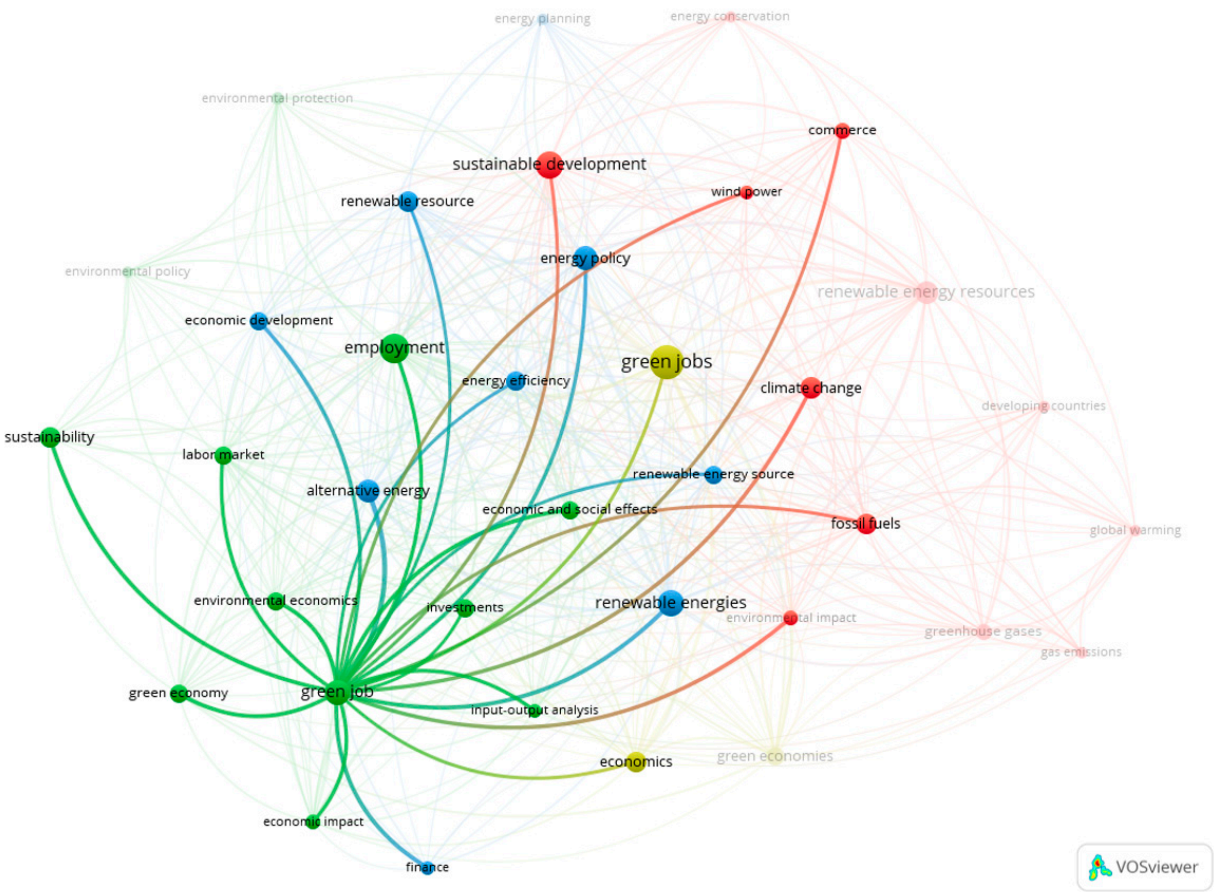

Figure 8. Keyword "green job" relations with other keywords. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

There are 25 keywords linked to the "green job" keyword presented in Figure 8. The colors of nodes and edges are the same as the clusters presented in Figure 3. The size of the label and the circle of an item is determined by the weight of the keyword, and its importance. The higher the weight of an item, the larger the label and the circle of the item [89]. The Figure 8 visualization consists of the links between keywords associated with "green job". The links between the different keywords in Figures 8–10 gradually change their colors. The links also show the distance between nodes of the subnetwork with the centrally placed keyword "green job". This distance approximately indicates the relatedness of the two keywords. The closer the two keywords co-occurred in publications, the closer the nodes are located to each other and the stronger their relatedness.

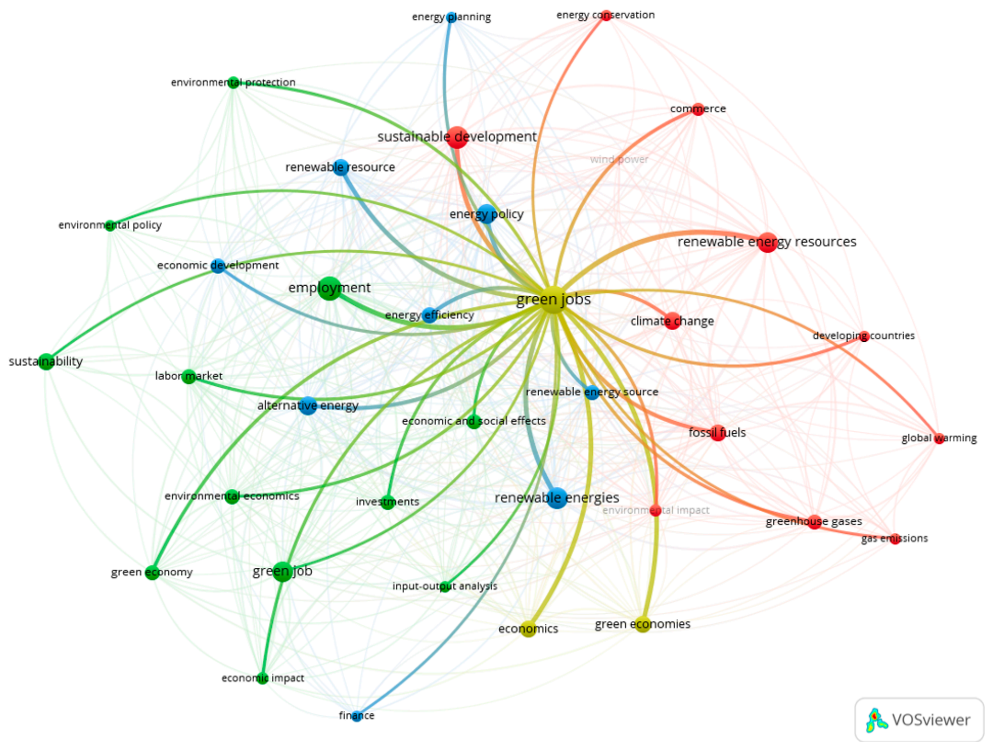

Figure 9. Keyword "green jobs" relations with other keywords. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

Next to the "green job" keyword presented in Figure 8, the plural form of this item is analyzed in Figure 9. In Figure 9, there are 33 keywords related to the centrally located "green jobs" keyword. This subnetwork has the same edges and nodes gradually changing colors as in Figure 3. This item "green jobs" belong to cluster 4 (Table 3) and has 34 links to other keywords, with a total link strength equal to 125, and has 33 co-occurrences in the explored results from the Scopus database [12].

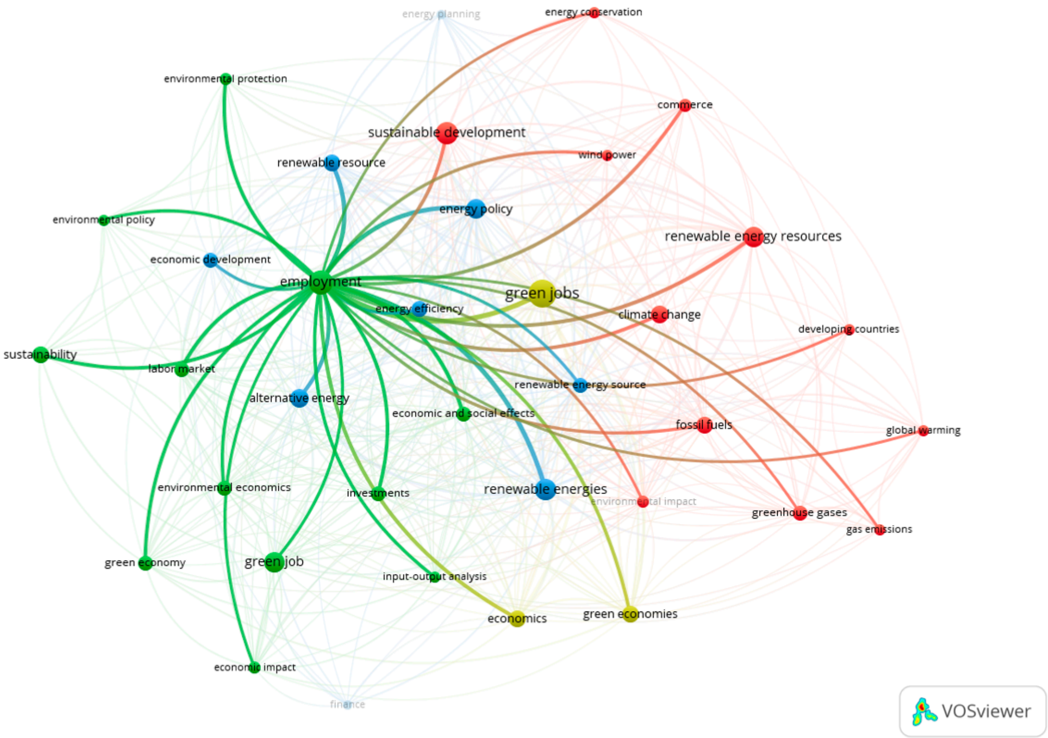

Figure 10. Keyword "employment" relations with other keywords. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

The keyword "employment" is the most numerous in the green cluster and also has the highest density, as presented in Figures 5 and 6. Therefore, the dynamic analysis was performed with this keyword as a central point of the newly presented subnetwork. There are 33 keywords linked to the "employment" keyword, as presented in Figure 10. The edges and nodes have the same colors as the clusters presented in Figure 3. This item "employment" belongs to cluster 2 (Table 3) and has 33 links to other keywords, with a total link strength equal to 114, and has 25 co-occurrences in the explored results from the Scopus database. The presented graphical analyzes illustrate the complexity of GJs in the energy sector subject.

The keyword "sustainable development" presented in Figure 11 is the most important item [87,88] in the red cluster identified in Table 3. When this item is selected in the network visualization, the subnetwork of the related keywords is presented dynamically; therefore, this visualization feature has been captured as a screenshot from VOSviewer. The keyword "sustainable development" was selected due to its importance, as presented in the item density map, and this item is the third most co-occurring keyword among the obtained results. This item belongs to the first cluster, has 30 links to other keywords, has a total link strength equal to 62, and has 22 co-occurrences in the explored results from the Scopus database.

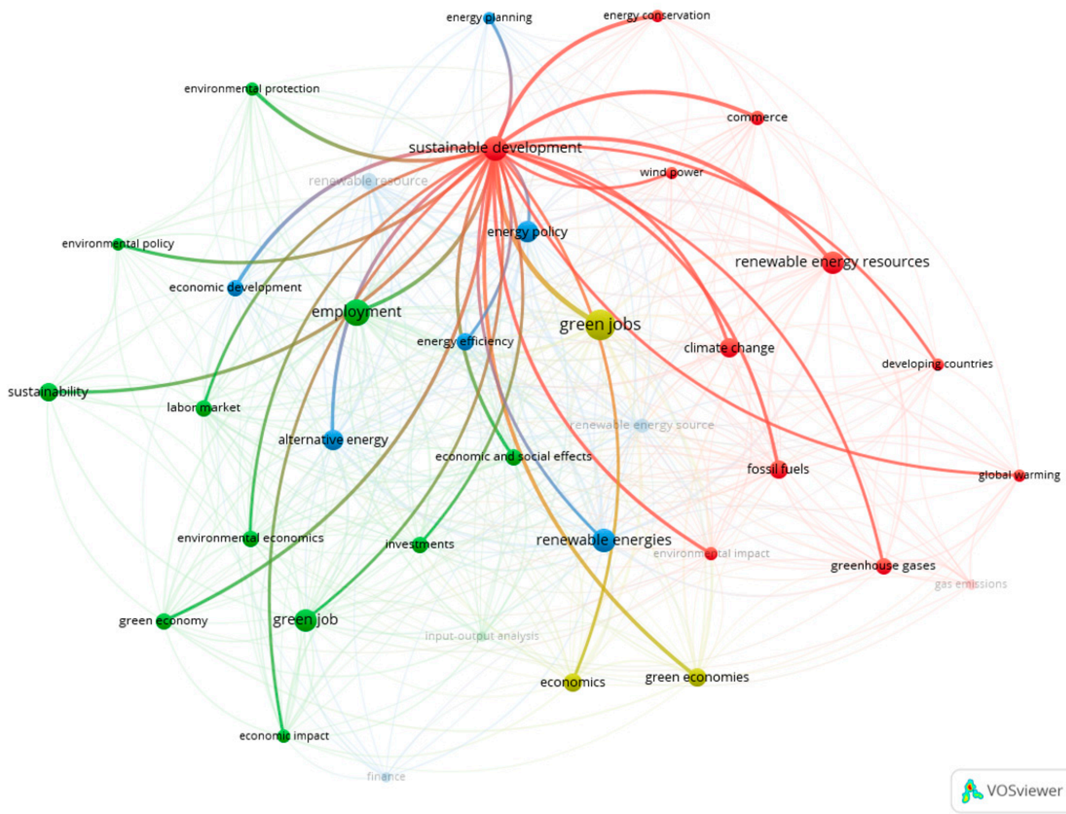

Figure 11. Keyword "sustainable development" relations with other keywords. Source: Authors' elaboration in VOSviewer software (1.6.18 version).

4. Discussion

The research focused on the issue of GJs in the energy sector [70] and proved that this subject is constantly evolving [66]. In the presented overlay analysis, it is noticeable that there is ongoing interest in the subject of GJs, and the topic is important for the energy sector [96]. The data presented in the overlay analysis keyword development (Figure 4) illustrate the increasingly growing interest in the explored subject. The multiple directions undertaken in the literature are connected to learning more about the factors influencing the number of GJs in the energy sector. These studies, however, generally deal with a rather narrow area of the energy sector, which is related to renewable energy generation [55,83]. In such cases, one can see a very frequent identification on the part of researchers of all jobs in the renewable energy sector with GJs [29]. This equivocation is often properly justified and is due to the lack of relevant statistics on the energy sector, but at the same time leads to a cognitive error as to the number of GJs in the energy sector [64]. In addition, one can see numerous discussions based on specific case studies (e.g., one or a few selected entities). The presented results proved that there are not only purely theoretical scientific considerations that dealt with the role and importance of GJs in the energy sector; there are also practical attempts to present specific features of GJs [29,97].

This distinction is visible in Figure 8, where the relations between "green job" and "green jobs" are explored. Based on theoretical analyses, it is noticeable that GJs are treated as a positive result of the green transformation of the energy sector [1,12,98]. Such jobs bring the energy sector closer to sustainability in economic, environmental, and social terms [12]. This observation has also been proven in this research, in Figures 3 and 5, where the significance of "sustainable development" as a keyword is presented. There is a centrally placed triangle of the three most co-occurring keywords in Figures 5 and 6, which indicate the intertwined relations between the sustainable development dimensions. The relations with the other keywords classified in the blue cluster, which are mostly connected to the energy sector, complement the other clusters, which revolve around GJs in the energy sector.

The dynamic analyses presented in Figures 8–11 prove the interdisciplinarity of the subject. The yellow cluster keywords related to economics have been reached differently by links in the presented analysis. In Figure 8, the single keyword from the yellow cluster "green economy" has not been linked in the dynamic network analysis. This result is correct because Figure 8 explores the relations between two grammatical forms, "green job" and "green jobs", singular and plural, respectively. There are two reasons for this strong relationship. The first comes from the English language, and those grammatical forms naturally co-occurred in the publications related to the subject. The second reason comes from attempts towards the specification of theoretical and general "green jobs" definitions in scientific literature and presents them as the more practical "green job", in examples, cases, and reports.

In the analyses undertaken to date, in the opinion of the authors of this article, there is no distinction between GJs and green self-employment. Among those identified in the analysis results, there is no indication for such a term or keyword. The concept of green self-employment is relatively new in the labor market area. It should be noted that, in terms of the energy sector, green self-employment is generally presented as a self-employment opportunity resulting from the green transformation of the sector [99]. In practice, in quantitative analyses, authors do not distinguish between the number of GJs and the number of green self-employed. Thus, this is a forward-looking line of research, which depends on access to statistical data for researchers that would be appropriately aggregated. At present, one can see the wrongful lumping together of the self-employed and those working under various contracts in the energy sector.

5. Conclusions

The Scopus database exploration performed in VOSviewer showed that there is a very important area linking the issue of GJs with energy issues, which is the issue of employment. In this area, it is noticeable that there is still not enough analysis undertaken around the qualifications and competencies required for GJs. In the opinion of the authors, this area should be much more widely explored as it is relevant to business practice [100]. The drive to move away from non-renewable energy sources and towards renewable energy sources is a challenge for every country, also in the area of the labor market. The green transformation of the energy sector can result in the creation of GJs [6,101]. However, at the same time, some of the workers hitherto employed in the energy sector will lose their jobs. For this reason, individual states need to develop active labor market policy models tailored to their needs to achieve a green transformation of the energy sector. In particular, these models should include measures aimed at investing in education. Existing employees in the energy sector should be allowed to retrain and become green employees. It should therefore not be forgotten that the green transformation of the energy sector cannot take place without suitably qualified workers.

Based on the analysis results, the authors proved that studies of a quantitative and qualitative nature more fully describe the issue of GJs in the energy sector. This type of research in the future should be conducted in energy sector entities to verify the number of people working in GJs and distinguish them from green self-employed. In addition, surveys of this type would allow an indication of the degree of greening and a qualitative assessment of GJs. From the perspective of the SDGs set by Agenda 2030 [54], these considerations should also be aimed at assessing whether the GJs surveyed simultaneously meet the criteria for a decent workplace [102].

Presented in this study, a bibliometric analysis of publications presents the complexity of the terms related to GJs in the energy sector. This interrelation of subjects, visible as the keywords network, proves the interdisciplinarity of the subject. The presented results can inspire other researchers who are looking for a research gap or are describing the state-of-the-art. Politicians and decision makers can be influenced by the presented contextualization of GJs in the energy sector and their meaning in the labor market.

The study was conducted using the Scopus database, and the results were analyzed using the VOSviewer software. The paper presents a comprehensive analysis of GJs in the energy sector, highlighting the key trends and themes that have emerged in the literature. The study makes several contributions to scientific, theoretical, business, and practical aspects of GJs in the energy sector, providing valuable insights for researchers, policymakers, and practitioners alike.

The paper presents a bibliometric analysis of GJs in the energy sector, which provides a comprehensive overview of the research on this topic. The analysis reveals the key trends, concepts, and themes in the research literature, which can help researchers identify research gaps and opportunities for future research. From a scientific perspective, the paper adds to the growing body of literature on GJs in the energy sector [103]. The study provides a comprehensive overview [104] of the research conducted in this field, highlighting the key trends and themes that have emerged [105]. The paper also contributes to the theoretical understanding of GJs in the energy sector by providing a comprehensive analysis of the key concepts and themes that have emerged in the literature. The study also sheds light on the various methodological approaches that have been used in the research on GJs in the energy sector, providing insights into the strengths and limitations of each approach. The paper contributes to the theoretical understanding of GJs in the energy sector by analyzing the various dimensions of sustainable development and their interrelationships. The paper also distinguishes between purely theoretical considerations and practical attempts to present specific features of GJs, which is important for a better understanding of the subject.

From a business perspective, the paper provides valuable insights into the labor market implications of the transition to renewable energy sources. The study highlights the importance of developing active labor market policy models that are tailored to the needs of individual states to achieve a green transformation of the energy sector [12]. The paper also emphasizes the importance of investing in education and training programs to ensure that the workforce is suitably qualified to support the transition to renewable energy sources.

From a practical perspective, the paper provides insights into the competencies and qualifications required for GJs in the energy sector. The study highlights the need for further analysis in this area and suggests that future research should be conducted in energy sector entities to verify the number of people working in GJs and distinguish them from the green self-employed.

From a methodological perspective, the paper provides a detailed description of the research [106] procedures used in the study, which has important implications for the future reproducibility of the study results. The paper also highlights the limitations of the study, such as the choice of the number of co-occurrences [1,56] and the lack of distinction between GJs and green self-employment. The authors also suggest reproducing the results presented in this research in future to compare them, which contributes to the methodological rigor of the study.

The authors of this article have so far recognized the lack of adequate considerations linking the issue of the impact of prosumer market development to the creation of GJs, or green self-employment in the energy sector. This is another research area on which researchers should focus as a promising research avenue. The development of the prosumer market may affect the increased demand for installers and maintainers of renewable energy equipment. Undoubtedly, one of the future directions of research on the issue of GJs in the energy sector should be the question of the qualifications related to GJs.

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