Journal of Operational and Strategic Analytics
https://www.acadlore.com/journals/JOSA

Multi-Criteria Analysis Techniques to Assist Decision-Making in Renewable Energy Supply Chains: A Review

Maedeh Fasihi*

Department of Management, Ayandegan Institute of Higher Education, 4681853617 Tonekabon, Iran

* Correspondence: Maedeh Fasihi (m.fasihi@aihe.ac.ir)

Received: 03-12-2024 **Revised:** 04-26-2024 **Accepted:** 05-07-2024

Citation: M. Fasihi, "Multi-criteria analysis techniques to assist decision-making in renewable energy supply chains: A review," *J. Oper. Strateg Anal.*, vol. 02, no. 02, pp. 92–106, 2024. https://doi.org/10.56578/josa020203.

Abstract: The pressing need to reduce reliance on petroleum in the energy sector and the increasing demand for environmental protection are driving research and practical endeavors in the management of renewable supply chains. Professionals, global institutions and scholars have widely acknowledged the importance of studying the correlation, between the performance of supply chains and renewable energy sources. It's important to delve into the articles in terms of the methodologies that have been used, the principal concerns addressed, the specific renewable energy sources focused on, and the performance indicators employed to optimize supply chains for renewable energies. This paper provides an analysis that improves the understanding of research in the realm of quantitative decision making for renewable energy supply chains. The analysis commences by searching for articles published. Subsequently, they are narrowed down to those that are most relevant. The article also addresses knowledge gaps in the literature. The findings provide a reference for researchers who are considering conducting studies in this area.

Keywords: Renewable energy; Supply chain; Multi criteria analysis; Decision making

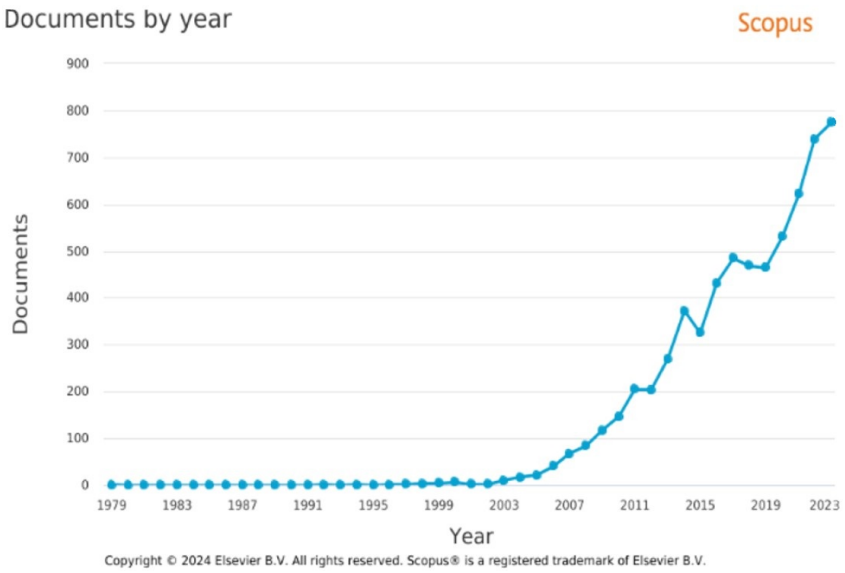
1 Introduction

Energy consumption has witnessed a substantial rise globally, especially in industrialized nations, primarily attributed to population growth, technological advancements, and improved living standards in recent times [1]. The significant surge in energy requirements, heightened worries regarding energy security, and the environmental repercussions associated with fossil fuel consumption have collectively driven a shift toward renewable energy sources [2]. The concept of renewable energy has found applications in various sectors. Renewable energy is derived from sustainable sources, including the sun, wind, waves, tides, marine, and geothermal energy, is becoming increasingly prevalent. Numerous countries worldwide have already integrated renewable energy into their energy supplies, and it is anticipated that national renewable energy markets will continue to grow significantly [3].

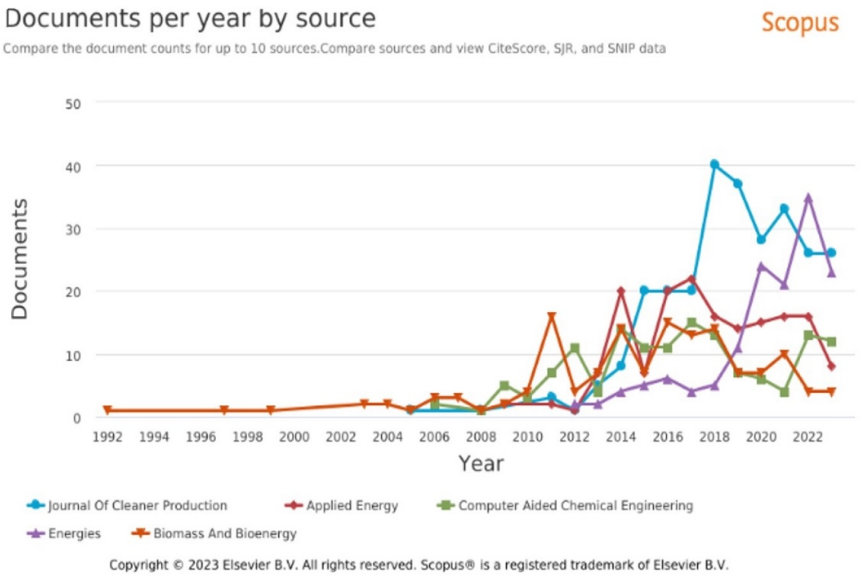
Supply chain management (SCM) is a component that orchestrates the movement of information, products, and finances from their source to various consumption areas [4]. The performance of the SC is undeniably a paramount factor for companies aiming not only to survive but also to thrive in today's fiercely competitive [5]. SCM in the context of renewable energy necessitates consideration of unpredictable factors and the performance of renewable energy systems, encompassing aspects like storage, distribution, conversion efficiency, and secondary applications. Renewable energy supply chains (RESCs) encompass familiar components of conventional SCM, involving the flow of physical, information, and financial resources. Through these practices, they play a vital role in promoting eco-friendly production processes, logistics, and products to enhance overall efficiency [6].

RESCs are now a prominent subject in academic discussions within the research domain of SCs. Factors such as economic shifts, political changes, and heightened consumer consciousness have led to the rapid expansion of RESCs in recent years [7]. This increase is evident in the growing number of publications in the field of RESCs in recent years (refer to more information in Figure 1). Table 1 shows the most recent reviews in RESCs.

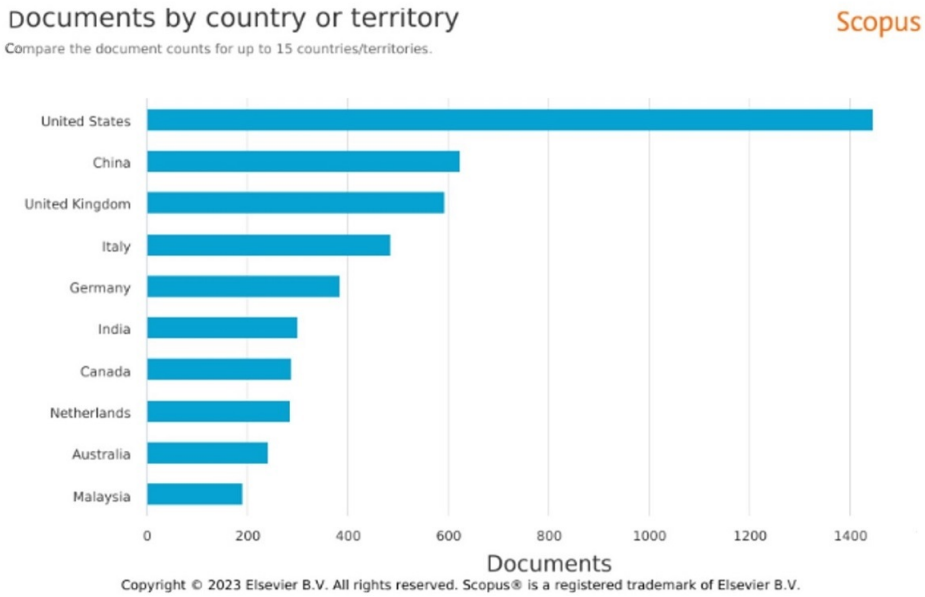
The structure of this paper is as follows: Section 2 outlines the research methodologies employed, Section 3 presents the key findings derived from the literature analysis, and finally, in Section 4, the principal conclusions are summarized.


Documents by year
Scopus
Documents
Year
Copyright © 2024 Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

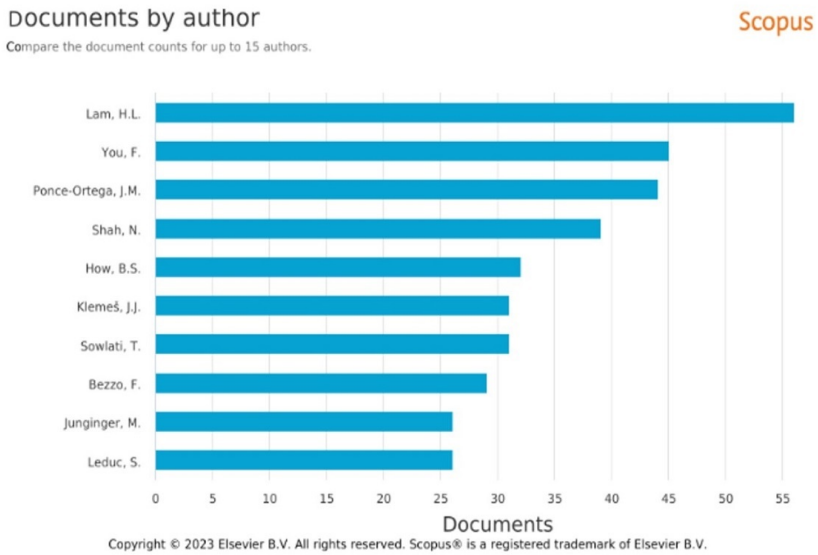
(a)


Documents per year by source
Scopus
Compare the document counts for up to 10 sources.Compare sources and view CiteScore, SJR, and SNIP data
Documents
Year
Journal Of Cleaner Production
Applied Energy
Computer Aided Chemical Engineering
Energies
Biomass And Bioenergy
Copyright © 2023 Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

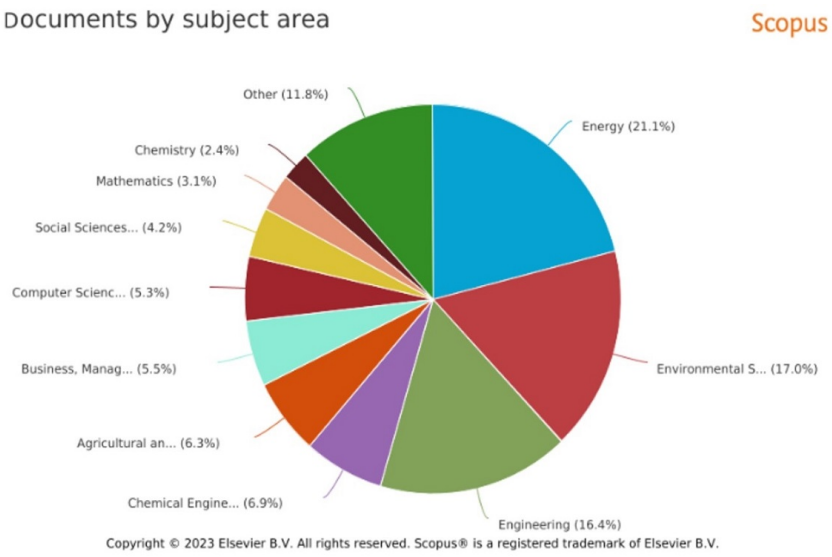
(b)


Documents by country or territory
Scopus
Compare the document counts for up to 15 countries/territories.
United States
China
United Kingdom
Italy
Germany
India
Canada
Netherlands
Australia
Malaysia
Documents
Copyright © 2023 Elsevier B.V. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

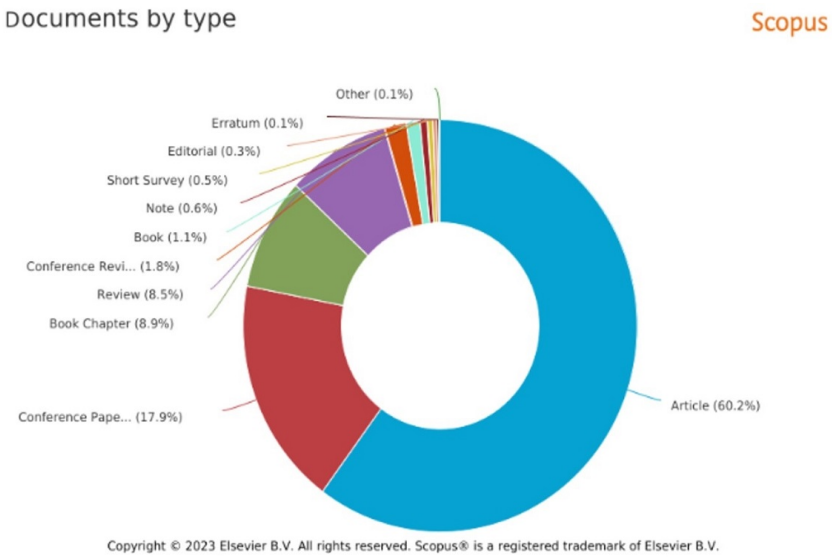
(c)



(d)



(e)



(f)

Figure 1. RESCs publication trend

Table 1. Recent reviews in the field of Renewable Energy Supply Chains (RESCs)

Paper	Year	Scope
[8]	2018	Sustainable and RESCs
[9]	2019	SC of renewable energy
[10]	2020	Biomass for energy: SCM models
[11]	2019	Optimization methods for biomass SC: Models and algorithms, sustainable issues, and challenges and opportunities
[3]	2022	sustainable issues, and challenges and opportunities
[2]	2022	Optimization solution methods applied to SC of solar energy
[12]	2022	Sustaiomasle SC design and planning: new trends, methodologies and applications
[13]	2022	Managing SC activities inerial decisions, and quantitative analytics of biomass SCs
[6]	2023	RESCs-text mining and co-occurrence analysis in the context of the sustainability

2 Research Methodology

The data utilized in this paper was sourced from the Scopus database covering the timeframe from 2018 to 2023. The analysis delves into a set of publications that applied quantitative multi-criteria analysis (MCA) techniques.

In the realm of literature, there exist various methods for categorizing MCA approaches. One widely recognized form of MCA is multi-criteria decision analysis (MCDA), which is sometimes referred to as multi-attribute decision analysis (MADA). It's important to note that the terms 'MCDA' and 'MCDM' (multi-criteria decision making) are frequently used interchangeably to refer to MCA. Since achieving optimal values for all objectives simultaneously is unattainable, MCDM entails addressing a selection problem [14].

Furthermore, these approaches are categorized into two main groups: multi-objective decision making (MODM) and multi-attribute decision making (MADM). The principal distinction between these two sets of approaches lies in the number of possible alternatives under evaluation. In MODM, an infinite number of alternatives are defined by constraints on a vector of decision variables, resulting in an optimized alternative. Conversely, MADM approaches, commonly applied in environmental decision-making scenarios, involve a finite number of explicitly defined alternatives, which are then assessed against a set of principles or criteria. These assessments often involve qualitative and/or quantitative attributes [15, 16].

Table 2. Keywords

Topic	Keywords
Renewable Energy	"renewable energy" OR "renewable resource" OR "bioenergy" OR "bio-energy" OR "biomass"OR "biofuel" OR "bio-fuel" OR "ethanol" OR "bioethanol" OR "wind energy" OR "wind power"OR "solar energy" OR "solar power" OR "photovoltaic cells" OR "geothermal energy" OR "heat energy" OR "ocean-power" OR hydropower OR "water-energy" OR "water power" OR "hydroelectric power" OR "landfill gas" OR "renewable fuel" OR "renewable sources"OR "renewable electricity" OR "renewable hydrogen" OR "renewable gases" OR "renewable power" OR "renewable jet fuel" OR "renewable water resources" OR "renewable-powered" OR "renewable diesel" OR "biojet fuel" OR "renewables" OR "renewable materials" OR "renewable heat"
Supply Chain	"supply chain*"
MCA	"multiple criteria" OR "multi-criteria" OR "multicriteria" OR "multiple attribute" OR "multiattribute" OR "multiattribute" OR "decision making process" OR "decision making technique" OR "decision making approach" OR "decision making method" OR "multiple alternative" OR "multi-alternative" OR "multialternative" OR "multi-dimensional decision-making" OR "multidimensional decision-making"

In this study, the title, abstract, and keyword search was conducted in the Scopus database. The choice of Scopus was made due to its status as the largest abstract and citation database for peer-reviewed scientific literature. Notably, it encompasses journals that are also part of the Web of Science and provides the capability for citation analysis. Similar to other databases, Scopus offers various features and functions that simplify bibliometric analysis.

The major keywords employed in this study, namely 'supply chain,' 'renewable energy,' and 'MCA,' were thoughtfully selected to align with the main research goal: to investigate the connection between SC decision-making

techniques and the adoption of renewable energies. Keywords related to various forms of renewable energy were chosen after a thorough literature analysis. These included 'renewable energy,' its synonyms, and alternative designations found in the literature. These keywords were used inclusively (linked by 'OR') to ensure comprehensive retrieval of articles encompassing all types of renewable energies. At the same time, we considered the keywords 'supply chain' and those associated with 'MCA,' stipulating their presence in the search fields (title, abstract, keywords) of each publication. This approach aimed to identify publications that address both SC-supported MCA techniques and specific types of renewable energy for analysis. Table 2 illustrates the use of various keywords for data collection.

Additionally, we limited our search to articles written in English, the predominant language of scientific communication, and to articles published in journals. Other forms of publication, such as books, book chapters, and conference proceedings, often do not adhere to the same standardized peer-review process and are therefore considered less credible sources for academic dissemination. Consequently, these sources were not included in our search criteria.

3 Findings and Discussion

The correlation between SCM and the adoption of renewable energies has garnered growing attention in scholarly literature, as depicted in Figure 1. There is a discernible upward trajectory in interest, particularly noticeable since 2015. Consequently, this not only signifies a rising area of interest but also a notably recent one. In this section, we outline the findings of our content analysis regarding the utilization of MADM techniques within the context of RESCs. According to the keywords mentioned in Table 2, the search results yield a collection of 153 studies on Scopus. Figure 2 illustrates the trends of these articles, and in terms of the number of publications, it is evident that a significant growth has been observed since 2018.

Table 3 presents the most pertinent publications, which encompass a type of renewable energy production and employ MCA-supported SCM, all of which were published after 2018. Sustainability Management refers to strategic business endeavors aimed at concurrently mitigating sustainability risks in the environmental, economic, and social dimensions [17]. In the realm of the renewable energy SC, scholars, managers, and vested parties can effectively employ insights derived from reviewed literature to align with their respective decision-making domains.

Table 3. The most relevant published works

Ref.	Year	Purpose of the Study	MCDM Method	Geographical Area	Main Findings/Results of the Study	Sustainability
[18]	2023	Modelling a sustainable integrated bio-fuel and bio-energy SC	Fuzzy-DEMATEL	India	Tackling the economic, environmental, and social dimensions of biofuel and bioenergy SCs	✓
[19]	2023	Modern animal traction to enhance the SC of residual biomass	SWOT	-	Fostering sustainable development initiatives at local and regional levels	✓
[20]	2023	Bioethanol sustainable SC design	BWM	Iran	Balancing sustainability criteria and transportation expenses within the bioethanol SC network	✓
[21]	2023	Optimal design of a biofuel SC	TOPSIS	Korea	Meeting the demand for lignocellulosic biomass, a key parameter	✓
[22]	2023	Evaluation of sourcing decision for hydrogen SC	AHP, DEA, Fuzzy AHP	Thailand	Addressing political acceptability as a paramount factor, especially in the context of Thailand	✓
[23]	2023	Strategic design of biofuel SC network	two-stage network DEA	USA	Identifying efficient logistics networks for biomass-based biofuels	-

Continued

Ref.	Year	Purpose of the Study	MCDM Method	Geographical Area	Main Findings/Results of the Study	Sustainability
[24]	2023	Agroforest woody residual biomass-to-energy SC analysis	PEST, SWOT	-	Optimization process for the entire SC	✓
[25]	2023	Life cycle cost assessment renewable natural gas	TOPSIS	-	Successfully implementing waste-to-renewable natural gas SC pathways	✓
[26]	2023	Circular economy of bio-SCs-agro-industry sector	AHP, TOPSIS	Spain	Dynamically selecting suppliers	✓
[27]	2023	Evaluation, ranking and selection of green suppliers in the SC	combination of DEA and AHP	-	Assessing and choosing the most environmentally friendly suppliers of wind turbine equipment	-
[28]	2023	Location optimization of feedstock cultivation in a biodiesel SC	DEA	Iran	Identifying suitable areas in Iran for cultivating Jatropha Curcas L. (JCL)	✓
[29]	2023	Modelling for the sustainable development hindrances in the RESC	Fuzzy ISM–DEMATEL	-	Offering unique insights into sustainability within renewable energy SCs	✓
[30]	2022	Identifying and classifying biomass SC challenges and prioritize them	AHP	Norway	Highlighting critical challenge indicators such as high investment costs and greenhouse gas emissions	-
[31]	2022	Decision-making on biomass terminal selection	AHP	Canada	Identifying terminals with the greatest potential to add value to the bioenergy SC	-
[32]	2022	Malaysia	Prioritizing locations for direct-use geothermal energy location	DEA, Spherical fuzzy AHP	Qualitatively assessing concerns for distribution grid logistics, including costs and social acceptance	-
[33]	2022	Iran	Life cycle evaluation of microalgae based biorefinery supply network	DEA, CODAS, BWM	Achieving a 99% reduction in greenhouse gas emissions	✓
[34]	2022	Australia	Site selection of offshore wind farms	BWM	Establishing a robust optimal ranking of potential site locations	✓

Continued

Ref.	Year	Purpose of the Study	MCDM Method	Geographical Area	Main Findings/Results of the Study	Sustainability
[35]	2022	Brazil	Effect of COVID-19 on green-fuel SC	Novel DEA	Revealing the negative impacts of the pandemic on all states, with some facing collapse risks	✓
[36]	2022	India	Prioritization of barriers to offshore wind energy	Fuzzy AHP	Compilation of barriers hindering progress	-
[37]	2022	Iran	Strategic supplier selection for RESC under green capabilities	Fuzzy BWM, WASPAS, COPRAS	Providing decision-makers with valuable guidance for strategic supplier selection	-
[38]	2022	Mexico	Multi-objective optimal design of a hydrogen SC powered with agro-industrial wastes from the sugarcane industry	TOPSIS	Optimal configuration selection for hydrogen SC networks	-
[39]	2022	Iran	A biofuel SC design considering sustainability, uncertainty, and international suppliers and markets	Fuzzy TOPSIS, Fuzzy BWM	Enhancing sustainability aspects	✓
[40]	2022	Qatar	Multi-biomass refinery siting	GIS-AHP	Maximizing biomass energy supply potential through optimal site selection and cost-effective transportation	✓
[41]	2022	Iran	Optimize a SC network for microalgae-based biofuels and co-products	AHP	Identifying suitable locations for microalgae cultivation	✓

Continued

Ref.	Year	Purpose of the Study	MCDM Method	Geographical Area	Main Findings/Results of the Study	Sustainability
[42]	2021	Iran	Bioenergy generation from the municipal solid waste	BWM	Enhancing social sustainability through waste utilization in bioenergy SCs	✓
[43]	2021	Malaysia	Biorefinery localization	AHP	Selecting biorefinery locations based on specified criteria	✓
[44]	2021	Taiwan	Site selection of solar photo-voltaic power plant	AHP, DEA	Recommending suitable cities for solar photovoltaic energy system construction	✓
[45]	2021	Iran	International MS municipal solid waste-to-biofuel SC design	DEA	Identifying appropriate locations for facility siting	✓
[46]	2020	Europe	Sustainable SC develop-ment in the renewable energy sector	AHP	Equipping decision-makers with tools for sustainable investment decisions in photovoltaic energy	✓
[47]	2020	-	Biofuel SC under demand uncertainty	MBW	Commercializing microalgae as a new energy source	-
[48]	2020	Iran	Bioethanol SC considering the bioethanol production strategies	BWM	Providing energy sector policymakers with an efficient decision-making tool	✓
[49]	2020	Iran	Strategic and tactical planning of a sustainable bioethanol SC	BWM	Implementing an effective ethanol distribution policy to reduce costs by 33%	✓
[50]	2019	International	Assessment of interna-tional biomass SC pathways	DEA	Assisting in biomass sourcing planning and decision-making improvements	-

Continued

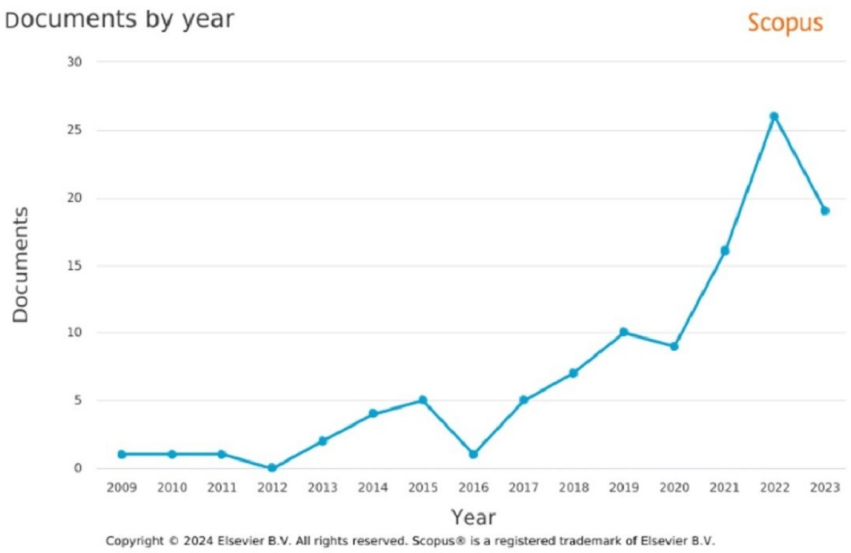
Ref.	Year	Purpose of the Study	MCDM Method	Geographical Area	Main Findings/Results of the Study	Sustainability
[51]	2019	Iran	Microalgae-based biobutanol SC network design under harvesting and drying uncertainties	DEA	Minimizing fixed construction, transportation, and operational costs	-
[52]	2018	Iran	Developing a sustainable SC optimization model for switchgrass-based bioenergy production	TOPSIS	Determining strategic and tactical decisions to manage bioenergy SC performance	✓
[53]	2018	-	Design of biomass (sugar/ethanol) SCs	AHP	Simplifying decision-making by offering solutions aligned with decision-makers' preferences	-

Analytic Hierarchy Process (AHP), Final Ranking of Alternatives (FRA), Best-Worst Method (BWM), Data Envelopment Analysis (DEA), Complex Proportional Assessment of Alternatives (COPRAS), Weighted Aggregated Sum-Product Assessment (WASPAS), Strengths, Weaknesses, Opportunities, and Threats (SWOT), Interpretive Structural Modelling (ISM), Combinative Distance-Based Assessment (CODAS), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)

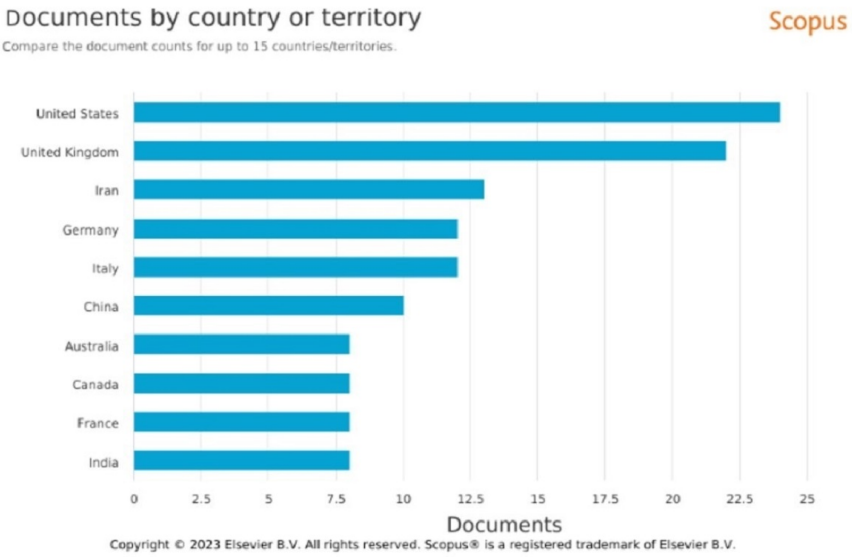
This paper utilizes keyword analysis as a bibliometric indicator. It employs the science mapping approach of bibliometric analysis, utilizing the visualization software VOSviewer to illustrate the subject structure [54]. VOSviewer Software was selected due to its robust graphical user interface and mapping visualization capabilities [55]. The data underwent standardization and formatting to make it compatible with VOSviewer. This process involved converting the database into plain text and thoroughly assessing all articles to ensure their relevance and accuracy. Ultimately, 36 records met the filtering criteria outlined above (refer to Table 3).

Keywords serve as fundamental components within a specific field of study, offering insights into the knowledge structure and research trends. Through keyword co-occurrence analysis, a network can be constructed where each node represents a keyword, and the links between nodes signify their co-occurrence. In this analysis, keywords initially included in the search were excluded to ensure a comprehensive examination of literature features, with a minimum threshold of 2 keywords required for inclusion in Figure 3. The construction of the keyword co-occurrence network involves assigning each keyword as a node and establishing edges based on keyword co-occurrences. When two keywords have a co-occurrence relationship, it indicates a connection between the respective nodes.

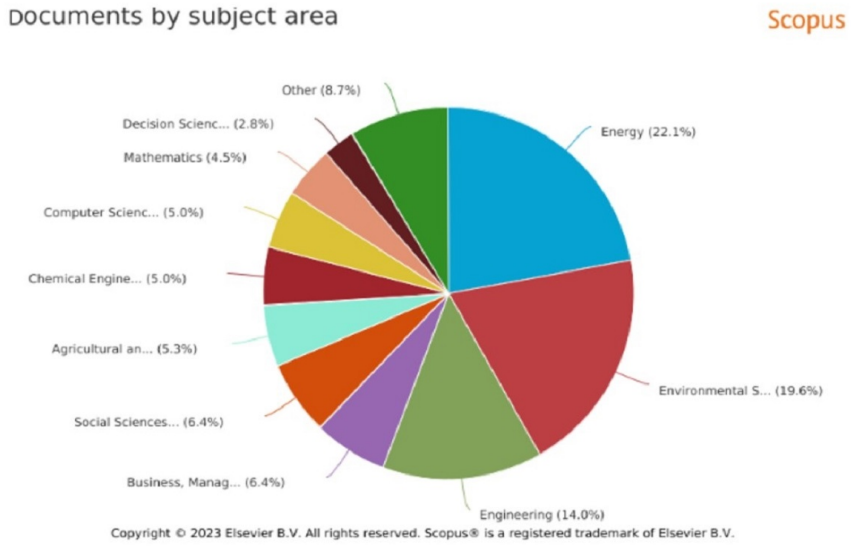
The keywords depicted in Figure 3 were generated from a prior analysis conducted using VOSviewer, which considered density, degree, centralization, and inclusiveness as representative indicators of keyword connections. Density reflects the ratio of formed relationships to total possible relationships, while centralization measures the concentration of relationships on a few individuals. Inclusiveness indicates the number of interconnected nodes in the network. Centrality analysis identifies key nodes and determines which keywords hold a central position within the network. Keywords positioned closely to one another are considered influential, with closed centrality being a crucial concept in co-occurrence word analysis.



(a)



(b)



(c)

Figure 2. RESCs aided MCA publication trend

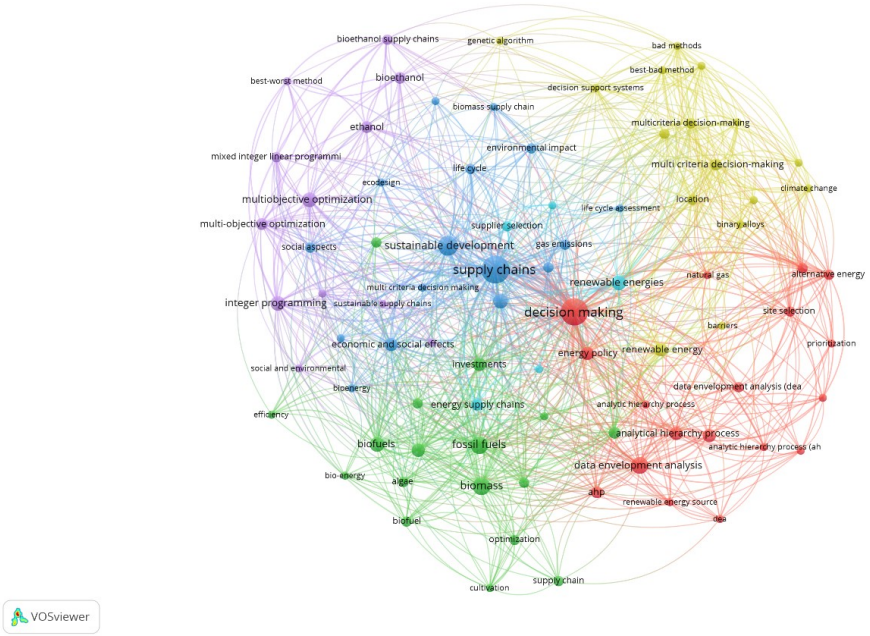


Figure 3. Network of co-occurring keywords

The methodology applied in this study revealed the presence of five primary clusters. The blue sub-network addresses supply chain issues, encompassing environmental concerns, sustainable development, environmental impact assessment, supplier selection and life cycle considerations. Notably, the blue cluster exhibits strong connectivity with the green cluster, indicating numerous links between them. The green cluster predominantly revolves around renewable energy resources, biomass and biofuels production issues, and energy supply chain management. Keywords related to programming, such as mixed integer linear programming, integer programming, and multi-objective optimization, form the purple cluster. The yellow cluster encompasses multi-criteria decision-making topics, including considerations for renewable energy and climate change. Lastly, the red cluster focuses on decision-making techniques, encompassing energy policy, alternative energy sources, and prioritization, with the Analytic Hierarchy Process (AHP) and Data Envelopment Analysis (DEA) methods emerging as pivotal within this cluster. Overall, the key themes in the analyzed articles center on sustainability, management, and optimization, particularly in the context of energy policy decision-making and the performance of renewable energy supply chains, with a notable emphasis on biomass-based energy.

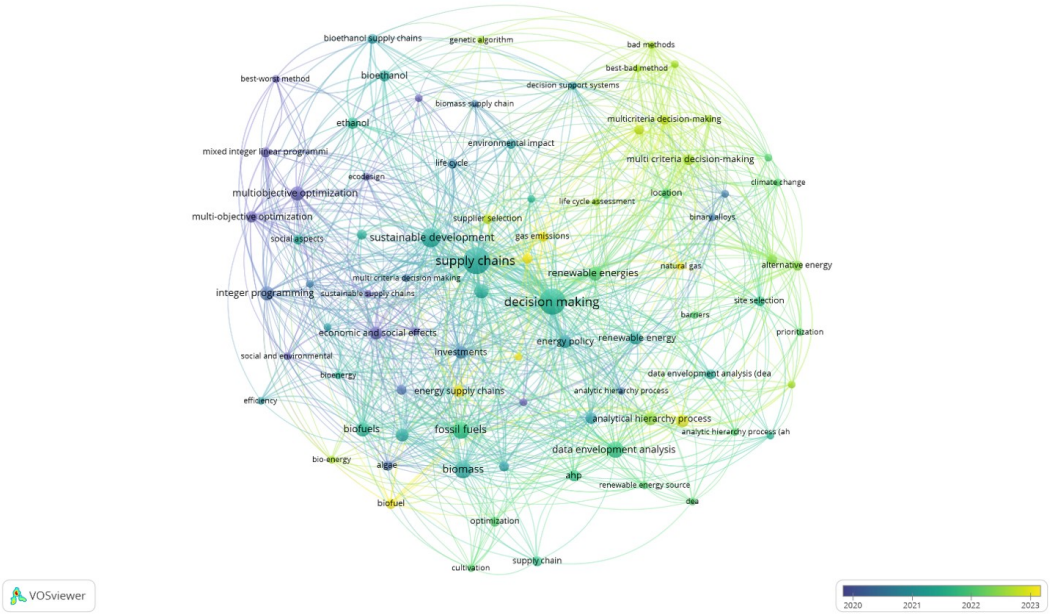


Figure 4. Overlay visualizations

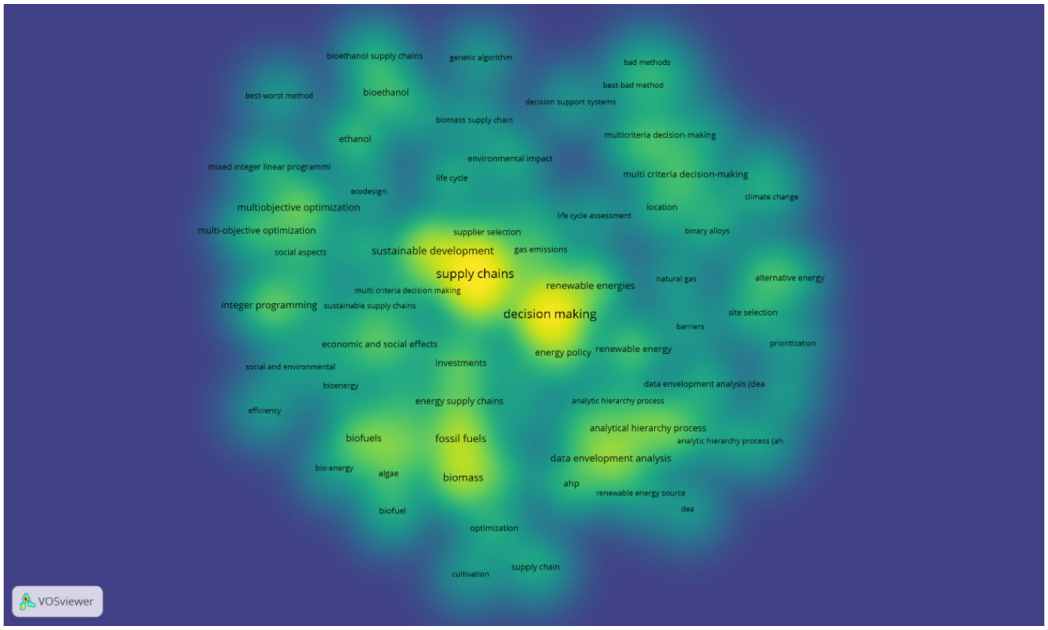


Figure 5. Density visualizations

The most prominent keywords identified in the literature include supply chains, sustainable development, multi-objective optimization, integer programming, biomass, biofuels, renewable energy, decision-making, DEA, and energy policy. This analysis underscores that the literature concerning renewable energies and supply chain performance is heavily influenced by the sustainability of biomass as a renewable energy source, with a strong emphasis on decision-making techniques, particularly DEA and AHP, alongside planning processes for supply chains, such as integer programming and multi-objective optimization. For further investigation, Figure 4 can be utilized to illustrate developments over time, while Figure 5 offers a quick overview of the main areas in a bibliometric network.

4 Conclusions

This overview presents and discusses several pertinent issues related to the application of MCA in RESCs. Bioenergy stands out as the most commonly utilized renewable energy source in these SCs. In terms of SC analysis, some studies have focused on the entire SC, while others have narrowed their focus to specific aspects of the bioenergy SC, such as distribution logistics.

Various literature reviews have concentrated on modelling techniques within sustainable SCM, highlighting how operational research methods and MCA can effectively reduce process costs. Within the realm of renewable energy analysis, the AHP emerges as the most frequently employed MCA methods. This study aims to identify the primary contributions and findings in current and future research using the MCA approach. Predominantly, the challenges in this field revolve around issues related to site selection and supplier selection. The central discovery of this study underscores the need for further research into the application of MCA approaches in the RESC, with a particular focus on thoroughly investigating the complete and comprehensive RESC. Furthermore, to align with the goals of sustainable development, social aspects should be integrated into SC analysis when sustainability is a primary target.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflict of interest.

References

[1] H. Ghaderi, M. S. Pishvaee, and A. Moini, “Biomass supply chain network design: An optimization-oriented review and analysis,” *Ind. Crops Prod.*, vol. 94, pp. 972–1000, 2016. https://doi.org/10.1016/j.indcrop.2016.09.027

[2] M. Mottaghi, S. Bairamzadeh, and M. S. Pishvaee, “A taxonomic review and analysis on biomass supply chain design and planning: New trends, methodologies and applications,” *Ind. Crops Prod.*, vol. 180, p. 114747, 2022. https://doi.org/10.1016/j.indcrop.2022.114747

[3] I. Rahimi and J. Nematian, "A bibliometric analysis on optimization solution methods applied to supply chain of solar energy," *Arch. Comput. Methods Eng.*, vol. 29, no. 6, pp. 4213–4231, 2022. https://doi.org/10.1007/s11831-022-09736-5

[4] M. Fasihi, R. Tavakkoli-Moghaddam, S. E. Najafi, and M. Hajiaghaei, "Optimizing a bi-objective multi-period fish closed-loop supply chain network design by three multi-objective meta-heuristic algorithms," *Scientia Iranica*, 2021. https://doi.org/10.24200/SCI.2021.57930.5477

[5] M. Fasihi, R. Tavakkoli-Moghaddam, M. Hajiaghaei-Keshteli, and S. E. Najafi, "Designing a sustainable fish closed-loop supply chain network under uncertainty," *Environ. Sci. Pollut. Res.*, vol. 30, no. 39, pp. 90 050–90 087, 2023. https://doi.org/10.1007/s11356-023-25877-x

[6] B. Tundys and T. Wiśniewski, "Renewable energy supply chains—text mining and co-occurrence analysis in the context of the sustainability," *Energies*, vol. 16, no. 12, p. 4761, 2023. https://doi.org/10.3390/en16124761

[7] I. G. Sahebi, A. Mosayebi, B. Masoomi, and F. Marandi, "Modeling the enablers for blockchain technology adoption in renewable energy supply chain," *Technol. Soc.*, vol. 68, p. 101871, 2022. https://doi.org/10.1016/j.techsoc.2022.101871

[8] M. R. S. Marroquin, C. H. D. O. Fontes, and F. G. M. Freires, "Sustainable and renewable energy supply chain: A system dynamics overview," *Renew. Sustain. Energy Rev.*, vol. 82, pp. 247–259, 2018. https://doi.org/10.1016/j.rser.2017.09.033

[9] S. G. Azevedo, M. Santos, and J. R. Antón, "Supply chain of renewable energy: A bibliometric review approach," *Biomass Bioenergy*, vol. 126, pp. 70–83, 2019. https://doi.org/10.1016/j.biombioe.2019.04.022

[10] L. J. R. Nunes, T. P. Causer, and D. Ciolkosz, "Biomass for energy: A review on supply chain management models," *Renew. Sustain. Energy Rev.*, vol. 120, p. 109658, 2020. https://doi.org/10.1016/j.rser.2019.109658

[11] O. Sun and N. Fan, "A review on optimization methods for biomass supply chain: Models and algorithms, sustainable issues, and challenges and opportunities," *Process Integr. Optim. Sustain.*, vol. 4, no. 3, pp. 203–226, 2020. https://doi.org/10.1007/s41660-020-00108-9

[12] M. Jazinaninejad, M. Nematollahi, A. S. Zamenjani, and A. Tajbakhsh, "Sustainable operations, managerial decisions, and quantitative analytics of biomass supply chains: A systematic literature review," *J. Clean. Prod.*, vol. 374, p. 133889, 2022. https://doi.org/10.1016/j.jclepro.2022.133889

[13] I. Hassanin and M. Knez, "Managing supply chain activities in the field of energy production focusing on renewables," *Sustainability*, vol. 14, no. 12, p. 7290, 2022. https://doi.org/10.3390/su14127290

[14] M. Fasihi, R. Tavakkoli-Moghaddam, and F. Jolai, "A bi-objective re-entrant permutation flow shop scheduling problem: Minimizing the makespan and maximum tardiness," *Oper. Res.*, vol. 23, no. 2, p. 29, 2023. https://doi.org/10.1007/s12351-023-00770-0

[15] T. Buchholz, E. Rametsteiner, T. A. Volk, and V. A. Luzadis, "Multi criteria analysis for bioenergy systems assessments," *Energy Policy*, vol. 37, no. 2, pp. 484–495, 2009. https://doi.org/10.1016/j.enpol.2008.09.054

[16] P. Korhonen, H. Moskowitz, and J. Wallenius, "Multiple criteria decision support-A review," *Eur. J. Oper. Res.*, vol. 63, no. 3, pp. 361–375, 1992. https://doi.org/10.1016/0377-2217(92)90155-3

[17] A. Cheraghalipour and S. Farsad, "A bi-objective sustainable supplier selection and order allocation considering quantity discounts under disruption risks: A case study in plastic industry." *Comput. Ind. Eng.*, vol. 118, pp. 237–250, 2018. https://doi.org/10.1016/j.cie.2018.02.041

[18] A. Mondal, B. K. Giri, and S. K. Roy, "An integrated sustainable bio-fuel and bio-energy supply chain: A novel approach based on DEMATEL and fuzzy-random robust flexible programming with Me measure," *Appl. Energy*, vol. 343, p. 121225, 2023. https://doi.org/10.1016/j.apenergy.2023.121225

[19] L. J. Nunes, J. Nogueira, J. B. Rodrigues, J. C. Azevedo, E. Oliveira, T. de Figueiredo, and J. Picos, "Modern animal traction to enhance the supply chain of residual biomass," *AgriEngineering*, vol. 5, no. 2, pp. 1039–1050, 2023. https://doi.org/10.3390/agriengineering5020065

[20] S. Kheybari, M. D. Monfared, A. Salamirad, and J. Rezaei, "Bioethanol sustainable supply chain design: A multi-attribute bi-objective structure," *Comput. Ind. Eng.*, vol. 180, p. 109258, 2023. https://doi.org/10.1016/j.cie.2023.109258

[21] M. Zarei, A. Cherif, H. J. Yoon, J. J. Liu, and C. J. Lee, "Optimal design of a biofuel supply chain using an augmented multi-objective and TOPSIS method," *Green Chem.*, vol. 25, no. 10, pp. 4067–4075, 2023. https://doi.org/10.1039/D2GC04670A

[22] K. Ransikarbum, W. Chanthakhot, T. Glimm, and J. Janmontree, "Evaluation of sourcing decision for hydrogen supply chain using an integrated multi-criteria decision analysis (MCDA) tool," *Resources*, vol. 12, no. 4, p. 48, 2023. https://doi.org/10.3390/resources12040048

[23] J. D. Hong, "Application of transformed two-stage network DEA to strategic design of biofuel supply chain network," *J. Syst. Sci. Syst. Eng.*, vol. 32, no. 2, pp. 129–151, 2003. https://doi.org/10.1504/IJISE.2020.110938

[24] L. J. Nunes, M. Casau, M. F. Dias, J. C. O. Matias, and L. C. Teixeira, "Agroforest woody residual biomass-to-energy supply chain analysis: Feasible and sustainable renewable resource exploitation for an alternative to fossil fuels," *Results Eng.*, vol. 17, p. 101010, 2023. https://doi.org/10.1016/j.rineng.2023.101010

[25] R. Kotagodahetti, K. Hewage, F. Razi, and R. Sadiq, "Comparative life cycle environmental and cost assessments of renewable natural gas production pathways," *Energy Convers. Manag.*, vol. 278, p. 116715, 2023. https://doi.org/10.1016/j.enconman.2023.116715

[26] V. Muerza, L. Urciuoli, and S. Z. Habas, "Enabling the circular economy of bio-supply chains employing integrated biomass logistics centers-A multi-stage approach integrating supply and production activities," *J. Clean. Prod.*, vol. 384, p. 135628, 2023. https://doi.org/10.1016/j.jclepro.2022.135628

[27] E. Shadkam, R. Yazdani, M. M. Mirmozaffari, and F. Adineh, "The hybrid DHP method for evaluation, ranking and selection of green suppliers in the supply chain," *Int. J. Math. Oper. Res.*, vol. 25, no. 1, pp. 118–138, 2023. https://doi.org/10.1504/IJMOR.2022.10048301

[28] Z. Mohtashami, A. Bozorgi-Amiri, and R. Tavakkoli-Moghaddam, "A data envelopment analysis model for location optimization of feedstock cultivation in a biodiesel supply chain: A case study," *Environ. Dev. Sustain.*, vol. 26, no. 4, pp. 10 513–10 532, 2024. https://doi.org/10.1007/s10668-023-03159-3

[29] I. Ghasemian Sahebi, S. P. Toufighi, M. Azzavi, B. Masoomi, and M. H. Maleki, "Fuzzy ISM–DEMATEL modeling for the sustainable development hindrances in the renewable energy supply chain," *Int. J. Energy Sect. Manag.*, vol. 18, no. 1, pp. 43–70, 2024. https://doi.org/10.1108/IJESM-05-2022-0024

[30] Z. Barahmand and M. S. Eikeland, "Assessing and prioritizing challenges facing bioenergy supply chain in Norway: A Delphi-AHP method," *Int. J. Energy Prod. Manag.*, vol. 7, no. 4, pp. 310–330, 2022. https://doi.org/10.2493/EQ-V7-N4-310-330

[31] S. Gautam, L. LeBel, and B. Rijal, "Integrating Analytical Hierarchical Process and network optimization model to support decision-making on biomass terminal selection," *Forests*, vol. 13, no. 11, p. 1898, 2022. https://doi.org/10.3390/f13111898

[32] M. T. Le, N. L. Nhieu, and T. D. T. Pham, "Direct-use geothermal energy location multi-criteria planning for on-site energy security in emergencies: A case study of Malaysia." *Sustainability*, vol. 14, no. 22, p. 15132, 2022. https://doi.org/10.3390/su142215132

[33] H. Mobarezkhoo, M. Saidi-Mehrabad, and H. Sahebi, "Life cycle evaluation of microalgae based biorefinery supply network: A sustainable multi-criteria approach," *Algal Res.*, vol. 66, p. 102816, 2022. https://doi.org/10.1016/j.algal.2022.102816

[34] C. B. Salvador, E. Arzaghi, M. Yazdi, H. A. Jahromi, and R. Abbassi, "A multi-criteria decision-making framework for site selection of offshore wind farms in Australia," *Ocean Coast. Manag.*, vol. 224, pp. 1–19, 2022. https://doi.org/10.1016/j.ocecoaman.2022.106196

[35] P. N. A. Junior, I. C. Melo, R. d. M. Santos, F. V. d. Rocha, and J. V. Caixeta-Filho, "How did COVID-19 affect green-fuel supply chain?-A performance analysis of Brazilian ethanol sector," *Res. Transp. Econ.*, vol. 93, no. 3, p. 101137, 2022. https://doi.org/10.1016/j.retrec.2021.101137

[36] T. Dhingra, A. Sengar, and S. Sajith, "A fuzzy analytic hierarchy process-based analysis for prioritization of barriers to offshore wind energy," *J. Clean. Prod.*, vol. 345, no. 4, p. 131111, 2022. https://doi.org/10.1016/j.jclepro.2022.131111

[37] B. Masoomi, I. G. Sahebi, M. Fathi, F. Yıldırım, and S. Ghorbani, "Strategic supplier selection for renewable energy supply chain under green capabilities (fuzzy BWM-WASPAS-COPRAS approach)," *Energy Strategy Rev.*, vol. 40, p. 100815, 2022. https://doi.org/10.1016/j.esr.2022.100815

[38] L. M. Reyes-Barquet, J. O. Rico-Contreras, C. Azzaro-Pantel, C. G. Moras-Sánchez, M. A. González-Huerta, D. Villanueva-Vásquez, and A. A. Aguilar-Lasserre, "Multi-objective optimal design of a hydrogen supply chain powered with agro-industrial wastes from the sugarcane industry: A Mexican case study," *Mathematics*, vol. 10, no. 3, p. 437, 2022. https://doi.org/10.3390/math10030437

[39] N. Zarrinpoor and A. Khani, "A biofuel supply chain design considering sustainability, uncertainty, and international suppliers and markets," *Biomass Convers. Bioref.*, vol. 13, no. 15, pp. 14 127–14 153, 2023. https://doi.org/10.1007/s13399-022-02804-7

[40] M. Alherbawi, G. Mckay, H. R. Mackey, and T. Al-Ansari, "A biofuel supply chain design considering sustainability, uncertainty, and international suppliers and markets," *Chem. Eng. Trans.*, vol. 92, pp. 73–78, 2022. https://doi.org/10.3303/CET2292013

[41] M. E. Zerafati, A. Bozorgi-Amiri, A. M. Golmohammadi, and F. Jolai, "A multi-objective mixed integer linear programming model proposed to optimize a supply chain network for microalgae-based biofuels and co-products: A case study in Iran," *Environ. Sci. Pollut. Res.*, pp. 1–23, 2022. https://doi.org/10.21203/rs.3.rs-733880/v1

[42] Z. Alidoosti, K. Govindan, M. S. Pishvaee, A. Mostafaeipour, and A. K. Hossain, "Social sustainability of treatment technologies for bioenergy generation from the municipal solid waste using best worst method," *J.*

Clean. Prod., vol. 288, p. 125592, 2021. https://doi.org/10.1016/j.jclepro.2020.125592

[43] N. H. Razak, H. Hashim, N. A. Yunus, and J. J. Klemeš, "Biorefinery localization using analytical hierarchy process," *Chem. Eng. Trans.*, vol. 89, pp. 589–594, 2021. https://doi.org/10.3303/CET2189099

[44] C. N. Wang, T. T. Dang, and J. Bayer, "A two-stage multiple criteria decision making for site selection of solar photovoltaic (PV) power plant: A case study in Taiwan," *IEEE Access*, vol. 9, pp. 75 509–75 525, 2021. https://doi.org/10.1109/ACCESS.2021.3081995

[45] M. Ghadami, H. Sahebi, M. Pishvaee, and H. Gilani, "A sustainable cross-efficiency DEA model for international MSW-to-biofuel supply chain design," *RAIRO-Oper. Res.*, vol. 55, pp. S2653–S2675, 2021. https://doi.org/10.1051/ro/2020104

[46] E. Mastrocinque, F. J. Ramírez, A. Honrubia-Escribano, and D. T. Pham, "An AHP-based multi-criteria model for sustainable supply chain development in the renewable energy sector," *Expert Syst. Appl.*, vol. 150, p. 113321, 2020. https://doi.org/10.1016/j.eswa.2020.113321

[47] F. Delkhosh and S. J. Sadjadi, "A robust optimization model for a biofuel supply chain under demand uncertainty," *Int. J. Energy Environ. Eng.*, vol. 11, no. 2, pp. 229–245, 2020. https://doi.org/10.1007/s40095-019-00329-w

[48] M. Rabbani, S. Momen, N. Akbarian-Saravi, H. Farrokhi-Asl, and Z. Ghelichi, "Optimal design for sustainable bioethanol supply chain considering the bioethanol production strategies: A case study," *Comput. Chem. Eng.*, vol. 134, p. 106720, 2020. https://doi.org/10.1016/j.compchemeng.2019.106720

[49] N. Akbarian-Saravi, M. Mobini, and M. Rabbani, "Development of a comprehensive decision support tool for strategic and tactical planning of a sustainable bioethanol supply chain: Real case study, discussions and policy implications," *J. Clean. Prod.*, vol. 244, p. 118871, 2020. https://doi.org/10.1016/j.jclepro.2019.118871

[50] A. Rentizelas, I. C. Melo, P. N. A. Junior, J. S. Campoli, and D. A. do Nascimento Rebelatto, "Multi-criteria efficiency assessment of international biomass supply chain pathways using Data Envelopment Analysis," *J. Clean. Prod.*, vol. 237, p. 117690, 2019. https://doi.org/10.1016/j.jclepro.2019.117690

[51] M. Arabi, S. Yaghoubi, and J. Tajik, "A mathematical model for microalgae-based biobutanol supply chain network design under harvesting and drying uncertainties," *Energy*, vol. 179, pp. 1004–1016, 2019. https://doi.org/10.1016/j.energy.2019.04.219

[52] R. Rabbani, N. A. Saravi, H. Farrokhi-Asl, S. F. W. Lim, and Z. Tahaei, "Developing a sustainable supply chain optimization model for switchgrass-based bioenergy production: A case study," *J. Clean. Prod.*, vol. 200, pp. 827–843, 2018. https://doi.org/10.1016/j.jclepro.2018.07.226

[53] J. Wheeler, M. A. Páez, G. Guillén-Gosálbez, and F. D. Mele, "Combining multi-attribute decision-making methods with multi-objective optimization in the design of biomass supply chains," *Comput. Chem. Eng.*, vol. 113, pp. 11–31, 2018. https://doi.org/10.1016/j.compchemeng.2018.02.010

[54] E. C. M. Noyons, H. F. Moed, and M. Luwel, "Combining mapping and citation analysis for evaluative bibliometric purposes: A bibliometric study," *J. Am. Soc. Inf. Sci.*, vol. 50, no. 2, pp. 115–131, 1999. https://doi.org/10.1002/(SICI)1097-4571(1999)50:23.0.CO;2-J

[55] N. J. van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," *Scientometrics*, vol. 84, no. 2, pp. 523–538, 2010. https://doi.org/10.1007/s11192-009-0146-3