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A Bibliometric Study of Renewable Energy from Waste

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Abstract

A bibliometric analysis of waste as a source of renewable energy is the aim of this research. This has to do with the generation of renewable energy from waste. Only English article were chosen, and the data source is Scopus with a 2008-2024time frame. There were 72 papers that were chosen. This study suggests that the generation of renewable energy from waste is a growing area of research.

Keywords: bibliometrics, waste, renewable energy.

1. INTRODUCTION

One of the environmental issues that all nations in the globe face is a waste (Abdel-Shafy and Mansour, 2018; Chen et al., 2020). The World Bank paper by Kaza et al. (2018) that summarizes their findings states that each person generates 0.74 kilograms (kgs) of waste each day. Along with population growth, waste also rises. With an estimated 8 billion people on the planet, 2.16 billion tonnes of waste are produced annually, or about 6 million tonnes every day.

According to information from statista.com. (2023), waste generation has significantly expanded globally over the past few decades and shows no signs of slowing down. Municipal generated waste is predicted to rise by around 70% to 3.4 billion metric tons by 2050, according to estimates. This is brought on by a number of causes, including consumer buying habits, urbanization, and economic expansion (UN-Habitat, 2020; Han et al., 2020; Singh, 2019).

When waste is improperly managed, it creates a problem. According to the World Bank's Data Topics website, 33% of the world's waste is not managed

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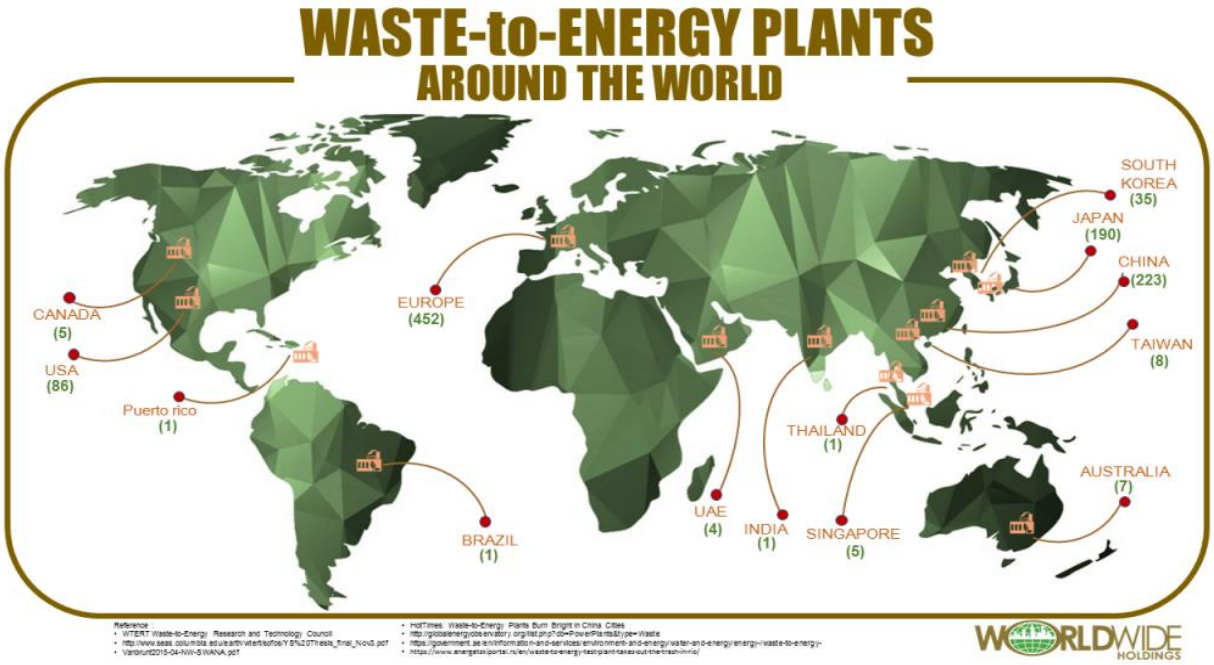
(datatopics.worldbank.org., 2023). Environmental conditions will worsen as a result of poor waste management (Hirpe and Yeom, 2021). As a result of improper waste management, environmental issues such as the spread of illness, floods, unsightly surroundings, and environmental contamination can arise (Alam and Ahmade, 2013; Evode et al., 2021; Li and Achal, 2020; Siddiqua et al., 2022). Unwise behavior is the cause of improper waste management (Khan et al., 2019). The majority of waste management practices that violate environmental health regulations take place in developing nations, where waste is frequently dumped anywhere, including into sewers, streams, and the ocean, landfills, and burned (Jambeck et al., 2015; Khan et al., 2019).

Many high-income countries are attempting to process waste in light of these circumstances. Energy is produced from waste (Luttenberger, 2020). It's not inevitable that waste can be converted into renewable energy (Nandy et al., 2022). By transforming waste into electrical energy, several nations have undergone transformations (Jaiswal et al., 2022).



Source: worldwideenvironment.com.my, 2023

Figure 1. Countries that Use Waste as an Alternate Source of Energy

Waste to energy conversion can lower pollution and greenhouse gas emissions and can be a significant source of energy for all nations (Hoang et al., 2022). Accordingly, the

purpose of this study is to conduct a review of the literature of works that have investigated the conversion of waste into energy. This article makes a contribution by offering something new in terms of the scientific trends and directions surrounding the use of waste as energy.

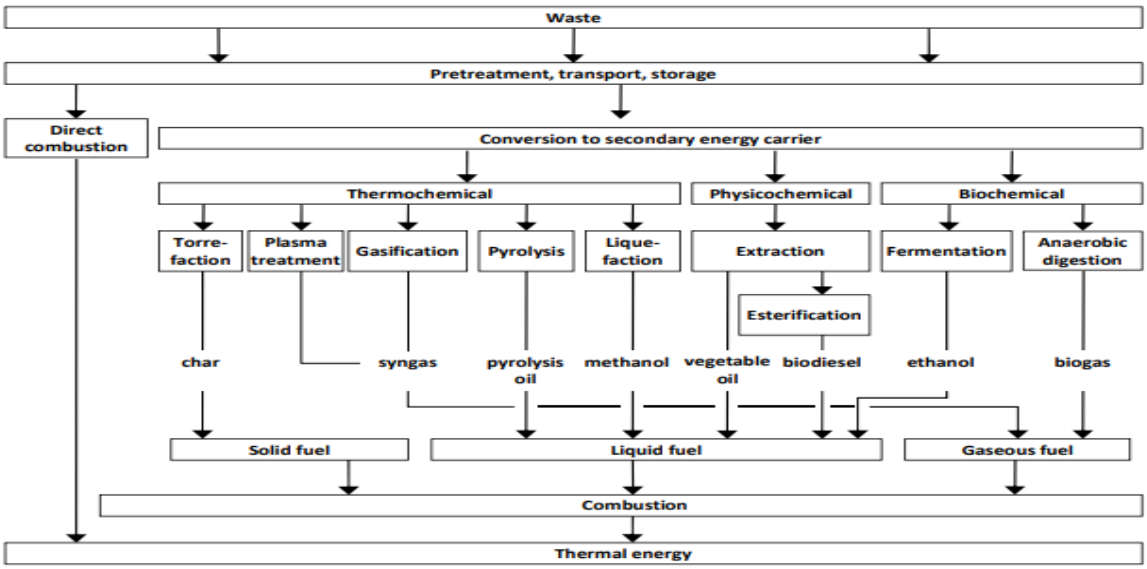
2. LITERATURE REVIEW

Sustainable development entails employing renewable energy (Madaleno et al., 2022). Sustainable development is a manner of development that makes use of the available natural resources (Mensah 2019). This sustainable development has the power to improve people's quality of life. Holden et al. (2016) define sustainable development as meeting currently occurring requirements without sacrificing the abilities of future generations. Economic, social, and environmental factors all interact to form the three interconnected elements of sustainable development. From an economic point of view, business activities must use resources wisely, economic growth must be resilient and sustainable, and natural resources must be preserved and resilient. This will allow for the suppression of negative environmental issues like pollution. This circumstance enables the social dimension to function effectively, especially by reducing poverty and empowering communities in accordance with their unique cultures. In order to achieve prosperity, these three dimensions are interconnected (del Rio dan Burguillo, 2008).

Current environmental issues must be resolved over the long run through sustainable development. Increased use of energy from renewable sources is one way to combat the approaching energy shortfall. Solar, wind, biomass, geothermal, and seawater tidal power are all sources of renewable energy (Alrikabi, 2014).

Biomass energy from waste is a renewable energy source that is being developed globally. By using technology to create energy, waste can be handled in this way. In addition to having the capacity to generate energy, electricity from waste can also lessen the harmful effects of untreated waste (Khan et al., 2022).

Figure 2 below illustrates how several methods are utilized to transform waste into energy.



Source: Bosman and Hesel, 2010

Figure 2. Technology Converts Waste into Energy

Figure 2 depicts two methods of using waste as a source of energy: direct combustion and following thermochemical, physicochemical, and the biochemical processes for energy conversion (Ali et al., 2020). By converting waste into thermal energy and steam, which is then used to drive a turbine attached to a generator to produce electricity, waste can be used to generate electricity (Bosmans and Hesel, 2010). de Souza et al., 2021; Baggio et al., 2008; Levidow and Raman, 2019; Margallo et al., 2014; Huang and Lo, 2020; Martinez et al., 2012; and Cudjoe, 2022 are just a few of the research that have looked at renewable energy from waste.

The conversion of waste into energy is being done for a variety of reasons, including to avoid filling up landfills to capacity, to cut greenhouse gas emissions, to lessen the harm caused by uncontrolled waste, and to boost the environment's carrying capacity (Qodriyatun, 2021).

3. RESEARCH METHOD

The examination and comprehension of data pertaining to the main objectives and issues of the research are accomplished through the employment of bibliometric approaches in this investigation. Bibliometrics is a qualitative approach. The process involves gathering data based on keywords, cleaning it up based on the analysis year, a few chosen scientific

works, and the language utilized. Data export in CSV (comma separated value) format is the following process. Ensure that citation information, bibliographic information, the abstract, keywords, and includes references to other material are initially selected before exporting data in CSV. This is done in order to use VosViewer's type of analysis.

The following criteria are chosen at the data collection stage:

1. The data issued cover the years 2008 through 2024.
2. Info extracted from Scopus.
3. The information used solely comes from English-language scientific studies that are focused on trash and renewable energy.

Steps of data screening:

1. 14,751 scientific papers were found when the terms "renewable energy" and "waste" were combined.
2. After choosing the years 2008–2024 and filtering the data by the categories of social sciences, economics, econometrics, finance, business, management, and accounting, choose 100 publications that are scientific works written in English.

There were 28 articles out of the about 100 articles that lacked essential words, resulting in the analysis of 72 articles. The 72 articles need to be cleaned up because some of them have similar keywords. To prevent keyword duplication or similarity, keywords must be cleaned. Efforts made to use the OpenRefine software for keyword leadership. The following flow chart illustrates the collecting, analysis, and visualization of data.

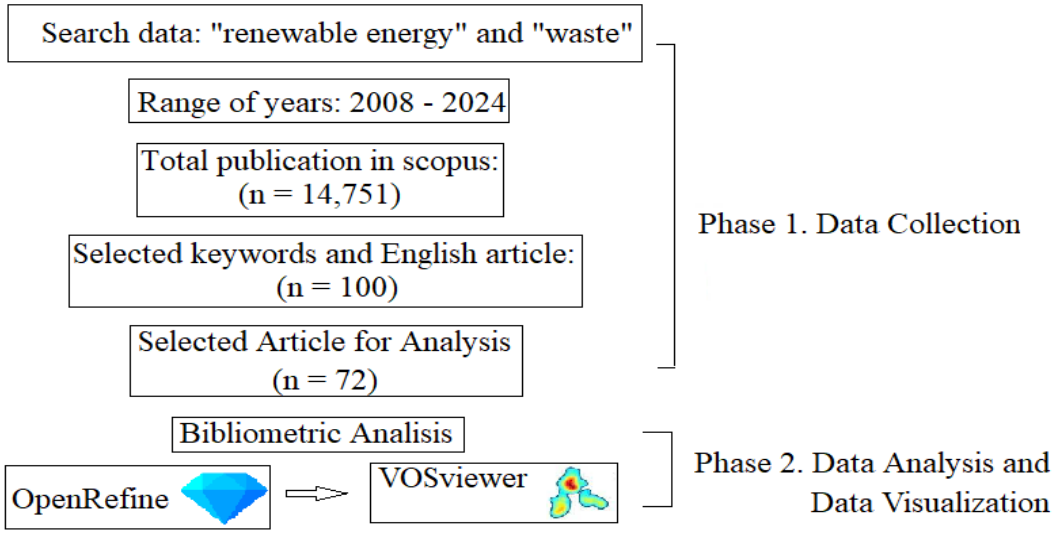


Figure 3. Flowchart Data Collection and Data Visualization

4. RESULT

The most journals were in 2019, and there were no articles with the chosen keywords in 2024, according to a searching for the results for the provided keywords and the chosen year range, 2008–2024. This is depicted in Figure 4 below.

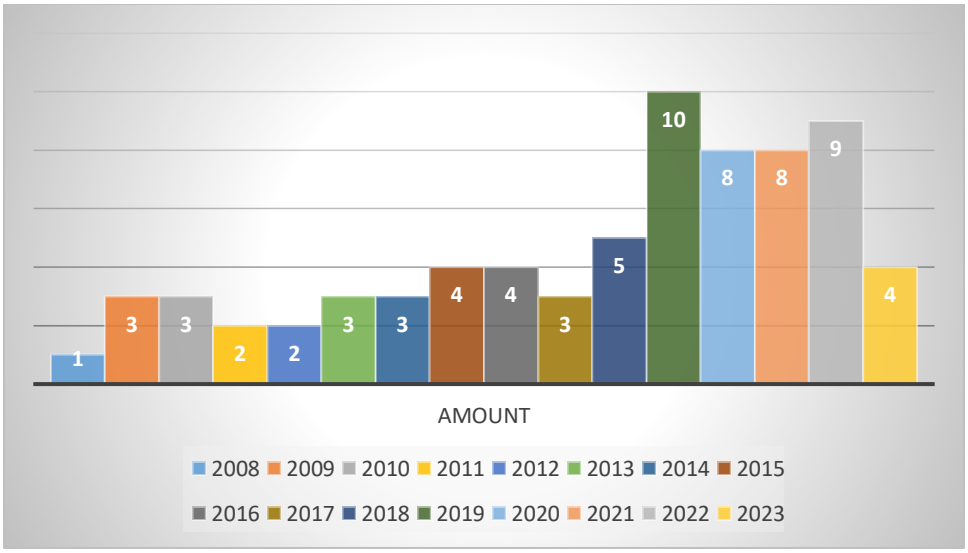


Figure 4. Extracted Journals Published 2008-2024

There are several keywords related to "renewable energy" and waste. In accordance with the Vosviewer software, the selected keywords are described as follows.

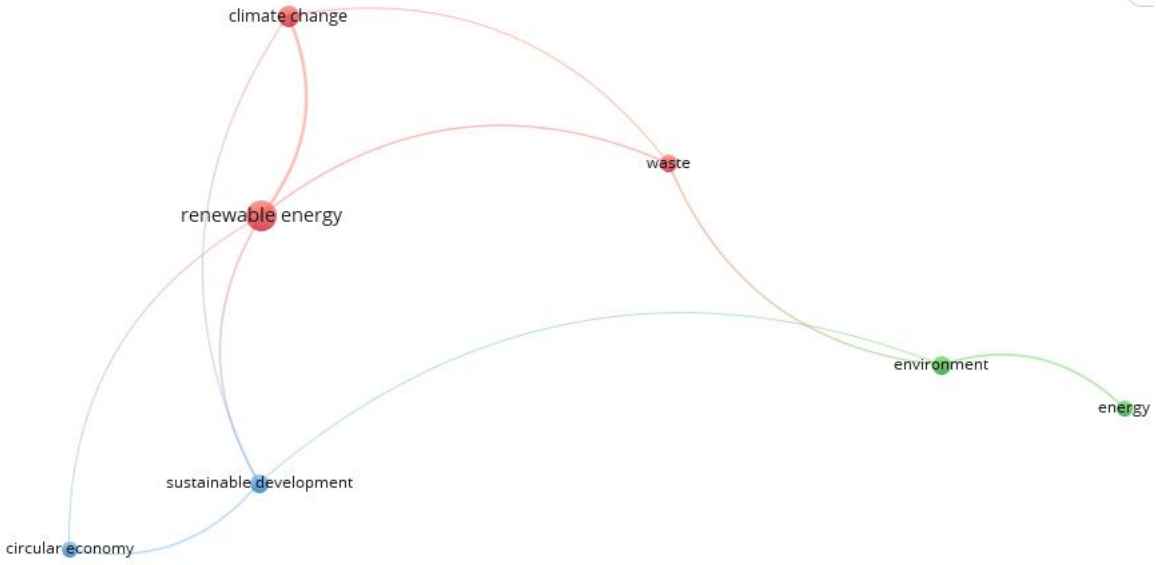


Figure 5. Co-occurrence of keywords written by the author

The keyword "renewable energy" has the most and the strongest networks with other keywords, as shown in Figure 5. Studies on renewable energy, particularly from waste, are being conducted a lot due to the fact that fossil fuels are becoming more and more scarce. According to overlay visualization, the top keywords currently are listed below.

The terms "waste" and "circular economy" have been popular since 2018, as shown in Figure 6.

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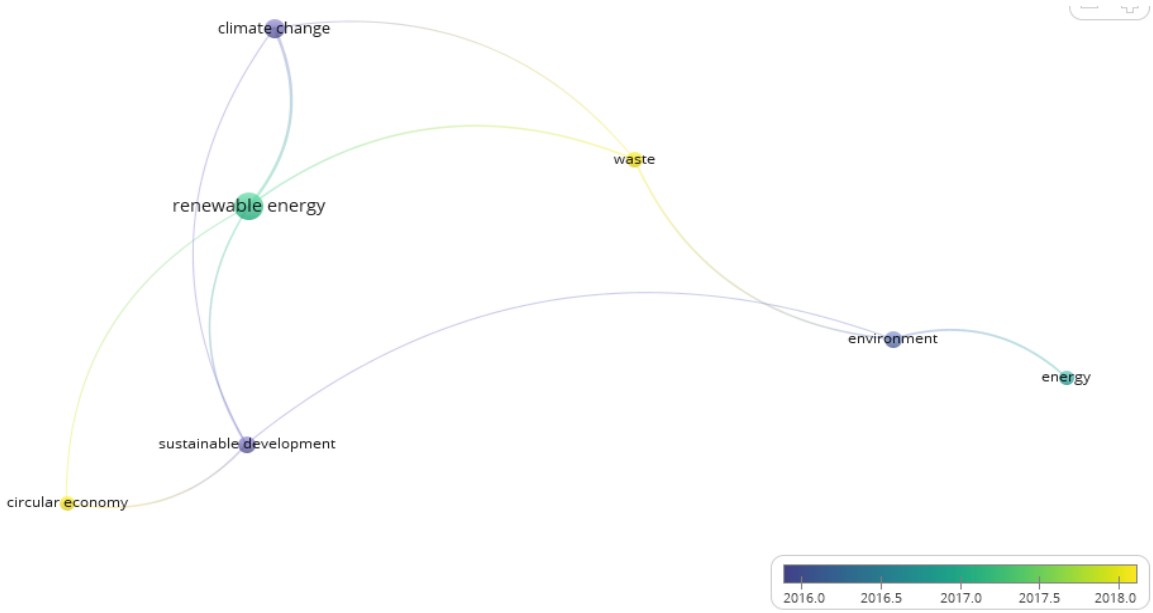

Figure 6: Author Keyword Co-occurrence Based on Overlay

Figure 7. Selected keywords

The most frequent and strongly associated keywords are displayed in Figure 8 (see below).

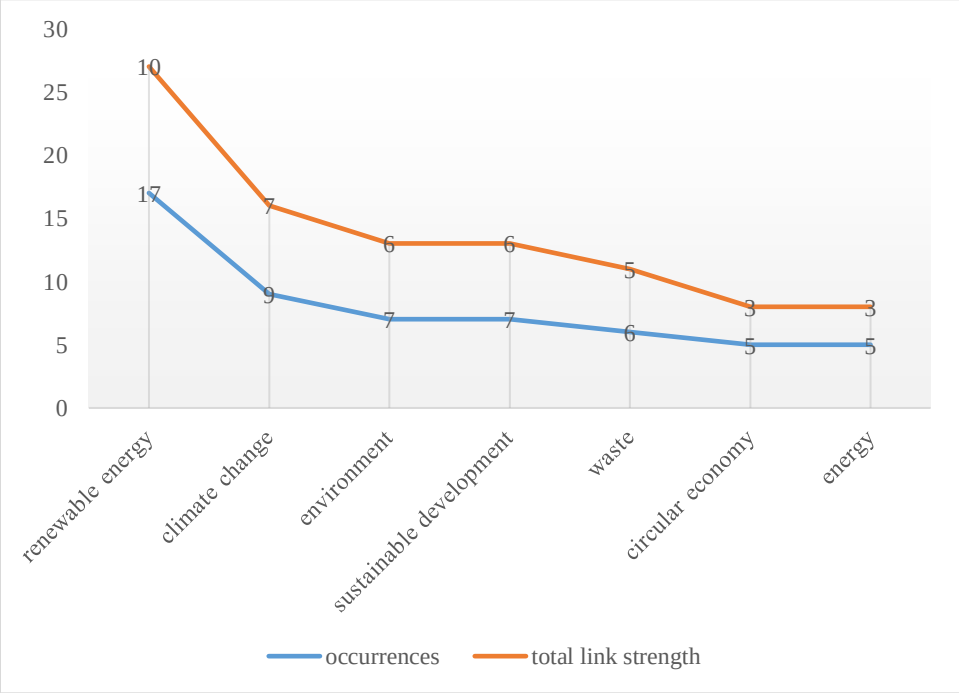

Figure 8. Keywords with the Most Occurrences and Total Link Strength

The term that is most frequently used and has the strongest associations is "renewable energy." This is a result of global efforts to replace fossil fuels, the supply of which is beginning to decline. Fossil energy also contributes significantly to global warming (Ali et al., 2020).

The article by Yoshino et al. (2021) received the most citations. It was quoted in 124 different papers in total. Taxes on CO2, NOx, and plastic pollution and trash were discussed in a study by Yoshino et al. (2021). The graphic below shows some further highly cited articles.

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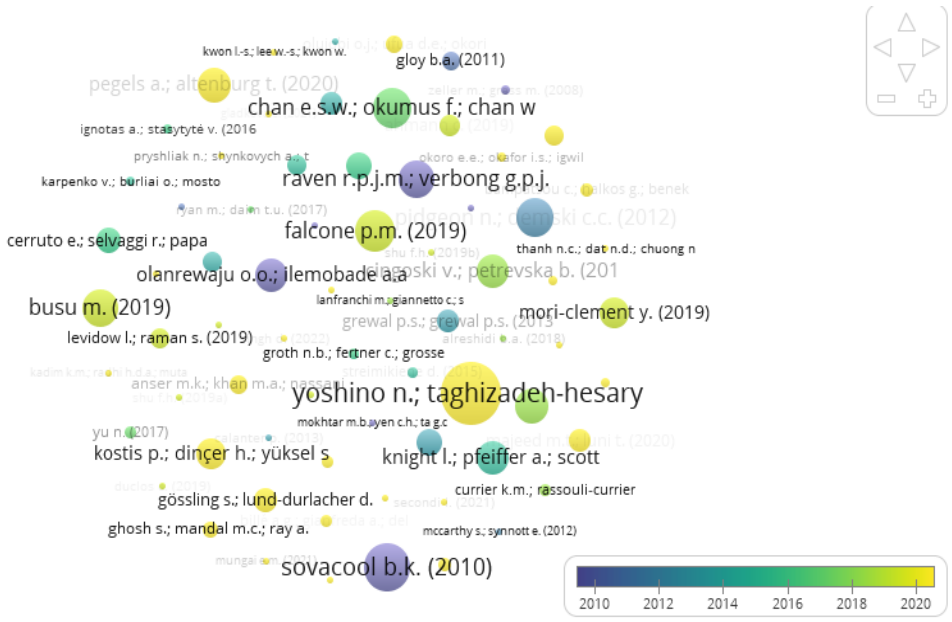

Figure 9. Articles with the most citations

According to Figure 9, the big circle represents an article written that has received a lot of citations, and the yellow circle represents the fact that the article is still relevant in terms of scientific research today.

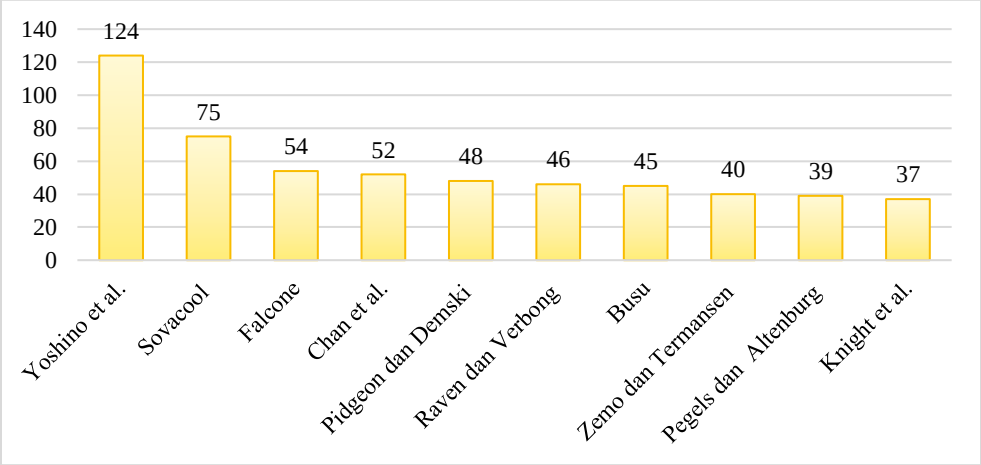

Figure 10. Ten Highly Cited Articles

Additional information from Figure 9 is provided in Figure 10. We chose 10 articles with a lot of citations. The originality of the subject, the analysis tools, and other factors all affect how many publications are cited. The following diagram shows the sources of the articles or journals that the articles were taken from, the number of times they were cited, and the total number of times they were cited.

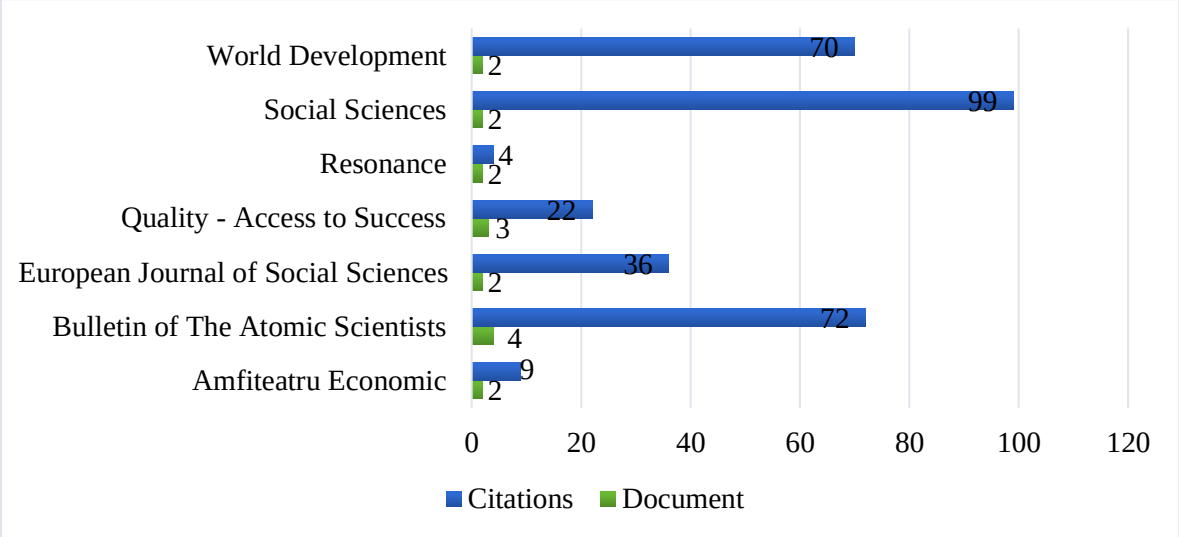

Figure 11. Frequently referenced article sources

According to Figure 11, articles that receive a lot of citations are from the Social Sciences. The Bulletin of The Atomic Scientists, however, is where the majority of publications may be found. Sources of articles that have been popular for authors to post their papers include the social sciences, global development, and resonance. The visualization that follows shows this.

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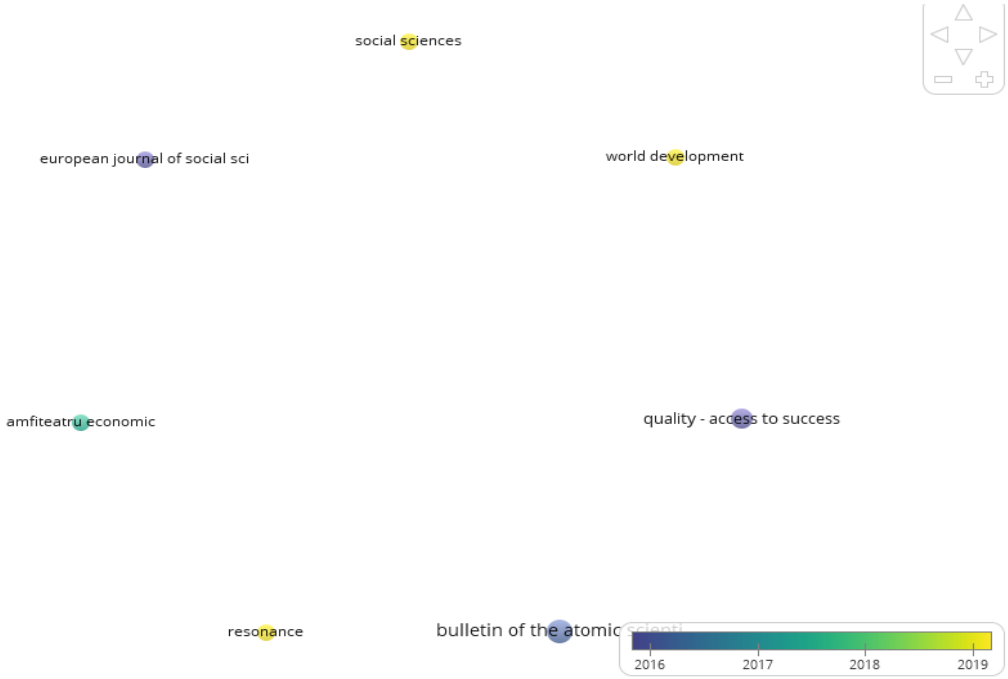

Figure 12. Article Source

According to Figure 12, the source of the article in yellow is the source of the trending article. Numerous articles have been published by this site in accordance with the chosen keywords, which is waste and renewable energy. In addition, the authors who are frequently quoted are from England, the United States, and Italy. This is shown in the next figure.

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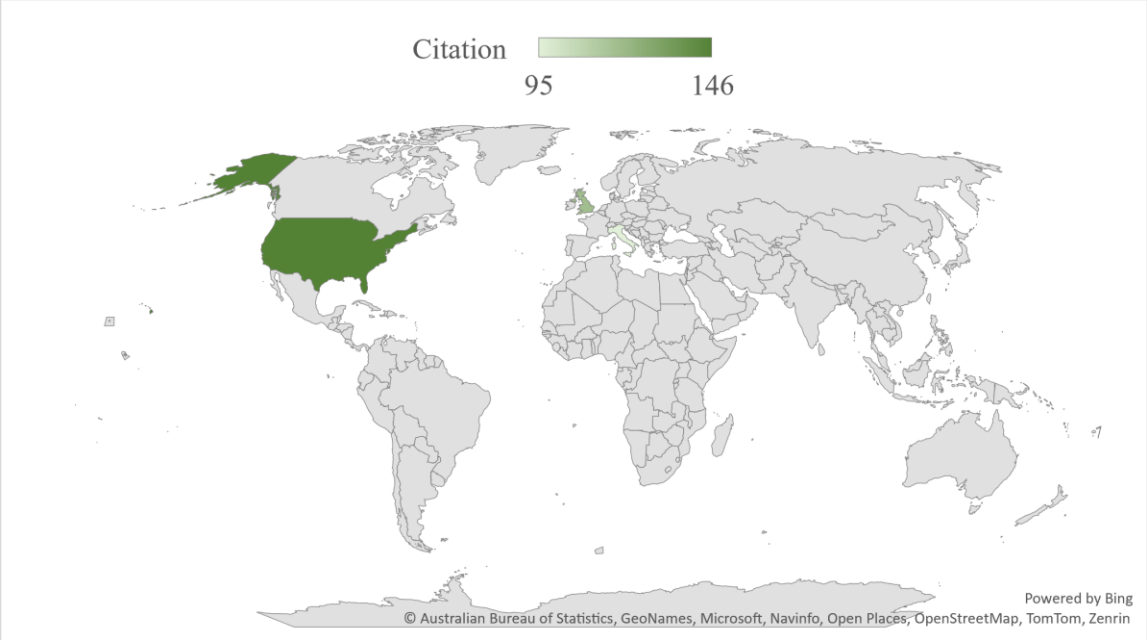

Figure 13. The Countries of Origin of the Most Cited Authors

Based on Figure 13, the table details are as follows.

Table 1. The Quantity of Publications and Citations from the Author's Country of Origin

Country	Document	Citation
Italy	6	95
United Kingdom	8	118
United States	11	146

The author's country of origin, as shown in Table 1, has the most documents, many of them are also cited. In regard to the fact that the United States has the greatest number of power plants that use landfill gas, several publications of this nation that explore this renewable energy source are frequently quoted by other writers.

5. DISCUSSION

Several articles explore waste as renewable energy, according to the bibliometric studies that were done. 14,751 articles covering the years 2008 to 2004 were discovered at the beginning of the data search. This demonstrates that using renewable energy is a requirement that must be put into place, given that the energy sources now in use are beginning to run out. The use of renewable energy has been the subject of numerous researches.

Waste is a different source of renewable energy (Khotari et al., 2010). Waste to energy conversion is widely practiced in several countries. This will lessen the harmful effects of unmanaged waste (Sridhar et al., 2021; Cudjoe dan Han, 2020). Developed nations are starting to understand how crucial it is to manage waste and then turn it into energy (Aftab et al., 2023). This is demonstrated by the numerous publications that have been written using case studies of developed countries like the United States, Italy, England, and others (Figure 13 and Table 1).

Many studies have been done in this area to discover new, alternative energy sources. The bibliometric analysis shows that new energy has been extensively studied (Figure 8). Renewable energy sources are not required in order to maintain environmental sustainability in the future. According to Owusu and Asumadu-Sarkodie (2016), this renewable energy source will help combat climate change, environmental sustainability, and sustainable development. To process new energy sources that can be used for as long as feasible, renewable energy is searched after. Sources of energy that replenished already-existing natural resources. Because it is a circular economic process, a product life cycle might last a very long time. This is due to the fact that waste is an issue with the environment that needs to be handled and that the circular economy is a system that promotes resource efficiency and economic growth that preserves the value of products, reducing environmental damage (Velenruf and Purnel, 2021).

Processing waste into energy is one way to put a circular economy into practice. Extending the life of a product is the goal of waste energy processing. Before the concepts of a circular economy and sustainable development, waste was seen to be an item with no value. Now, waste is thought to be an item with worth. Waste's negative consequences can be mitigated by giving it a value (Rizwan et al., 2018).

According to Cudjoe and Han (2020) and Zorpas (2020), waste that is turned into energy can generate between 500 KW and 10 MW of electricity while also lowering pollutants. If waste isn't managed it can contribute to greenhouse gas emissions (Qodriyatun,

2020). As a result, it is possible to make measures to extend the life of items so that they do not become waste. Many research investigations on waste management have been conducted, starting with technological considerations, environmental effects, economic effects, and others. Apart from circular economics, publications regarding waste have been written about frequently, according to the bibliometric analysis that was done (Figure 6). This demonstrates that waste management is a problem that must be adequately addressed in order to make the environment cleaner and more sustainable.

6. CONCLUSION

Waste management and renewable energy are still current issues for articles. This is due to the fact that waste is an environmental issue that requires more attention, and measures to combat it involve converting it into energy. Waste energy can be used as a renewable energy source to replace fossil fuels. 72 publications could be utilized as references to producing upcoming scientific papers, notably for writers from Indonesia, according to searches utilizing bibliometric analysis. Given that improper waste management continues to exist in Indonesia.

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