FIRAT ÜNİVERSİTESİ
SOSYAL BİLİMLER DERGİSİ
Journal of Social Sciences
p-ISSN:1300-9702 e-ISSN: 2149-3243

A SOCIAL MEDIA SENTIMENT ANALYSIS ON RENEWABLE ENERGY FORMS

Yenilenebilir Enerji Türleri Üzerine Bir Sosyal Medya Duygu Analizi

Hafize Nurgül DURMUŞ ŞENYAPAR[1]

[1]*Öğr. Gör. Dr., Gazi Üniversitesi, Kalite Koordinatörlüğü, Ankara, nurguld@gazi.edu.tr,* orcid.org/0000-0003-0927-1643

Araştırma Makalesi/Research Article

Makale Bilgisi
Geliş/Received:
11.12.2023
Kabul/Accepted:
13.01.2024

DOI:
10.18069/firatsbed.1403552

Keywords
Renewable energy, Sentiment analysis, Social media discourse, Marketing communication

ABSTRACT

This study conducts a sentiment analysis of public opinions on various energy sources, including hydro, solar, wind, and nuclear, using data from social media platforms like Facebook, Instagram, Quora, and Reddit. A dataset of 3,269 mentions and examining interactions, shares, and likes offers an extensive view of the current discourse on these energy forms. The methodology combines quantitative sentiment analysis with qualitative content examination to uncover underlying themes. The findings reveal strong positive sentiment towards renewable energy, mainly hydro and solar power, often described as "clean," "sustainable," and "efficient." Hydro energy is highly regarded due to its minimal environmental impact, while solar energy is praised for combating climate change and technological advancements. Wind energy faces criticism for visual and noise pollution concerns and potential effects on wildlife, while nuclear power generates negative sentiments primarily due to safety and waste management issues. These results have important implications for shaping effective marketing strategies within the renewable energy industry.

Anahtar Kelimeler
Yenilenebilir enerji, Duygu analizi, Sosyal medya söylemi, Pazarlama iletişimi

ÖZ

Bu çalışma, Facebook, Instagram, Quora ve Reddit gibi sosyal medya platformlarından elde edilen verilerle hidro, güneş, rüzgâr ve nükleer gibi çeşitli enerji kaynakları hakkındaki halk görüşlerinin duygu analizini gerçekleştirmektedir. 3,269 bahsetme verisi ile etkileşimler, paylaşımlar ve beğeniler incelenerek bu enerji formlarıyla ilgili güncel tartışmalara kapsamlı bir bakış sunulmaktadır. Yöntem, duygu analizini nicel verilere dayandırarak altta yatan temaları ortaya çıkarmak için nitel içerik incelemesiyle birleştirilmektedir. Sonuçlar genellikle "temiz," "sürdürülebilir" ve "verimli" olarak tanımlanan yenilenebilir enerjiye, özellikle hidro ve güneş enerjisine karşı güçlü bir olumlu duygu ortaya koymaktadır. Hidro enerjisi, çevresel etkisinin minimum olduğu algısı nedeniyle yüksek bir itibara sahiptir; güneş enerjisi ise iklim değişikliği ile mücadele ve teknolojik ilerlemeler için övgü almaktadır. Rüzgâr enerjisi, görsel ve ses kirliliği endişeleri ve potansiyel vahşi yaşam etkileri nedeniyle eleştirilirken nükleer enerji güvenlik ve atık yönetimi sorunları nedeniyle olumsuz duygular uyandırmaktadır. Bu sonuçlar, yenilenebilir enerji endüstrisi içinde etkili pazarlama stratejileri oluşturmak için önemli sonuçlar sunmaktadır.

Atıf/Citation: Durmuş Şenyapar, H. N. (2024). A Social Media Sentiment Analysis on Renewable Energy Forms. *Fırat Üniversitesi Sosyal Bilimler Dergisi,* 34, 1, 319-334.

Sorumlu yazar/Corresponding author: Hafize Nurgül DURMUŞ ŞENYAPAR, nurguld@gazi.edu.tr

1. Introduction

Renewable energy sources can be replenished naturally in a relatively short time, unlike fossil fuels like coal, oil, and natural gas, which are finite and take millions of years to form (Olabi & Abdelkareem, 2022). The main types of renewable energy include solar power, harnessed from the sun's rays; wind power, generated by the movement of air; hydroelectric power, derived from the flow of water in rivers or dams; geothermal energy, which utilizes heat from the Earth's core; and biomass, which is energy from plant and animal matter (Li et al., 2022; Liang et al., 2020; Lund & Toth, 2021; Uddin et al., 2019). These sources are significant for several reasons. They are environmentally benign because they release few to no greenhouse gases or pollutants, aiding in the fight against climate change and reducing air and water pollution (Chen et al., 2023; G. Wang et al., 2022). Renewable energy sources are sustainable, ensuring a long-term energy supply without depleting natural resources. Fossil fuels, on the other hand, are limited and subject to unstable markets (Oliveira et al., 2021; Razmjoo et al., 2021). Renewable energy can lead to energy independence for countries, reducing reliance on imported fuels and enhancing national security. Moreover, the renewable energy sector drives economic growth and job creation (Barone et al., 2021; Ram et al., 2020). As these technologies advance and become more widespread, they offer numerous opportunities for innovation and employment in various industries, including manufacturing, installation, maintenance, and research and development (Haldar & Sethi, 2022; M. Wang et al., 2019). Renewable energy sources play a pivotal role in promoting environmental sustainability, economic growth, and energy security, making them an indispensable component of our efforts to build a cleaner, more sustainable future (Chien et al., 2021; Mahmood et al., 2019; Viviescas et al., 2019). Hydraulic energy, also known as hydro power or water power, is a form of energy derived from the force or energy of moving water. It has been used for centuries to perform various tasks, such as grinding grain or sawing wood. In its modern use, hydraulic energy typically refers to the generation of electricity through the use of water. Hydraulic energy is a renewable resource that uses the Earth's water cycle to generate power. It is also considered a clean energy because it does not produce direct greenhouse gas emissions or air pollutants during operation (Bilgili et al., 2021). However, the construction of large dams and the subsequent flooding of large areas can have significant environmental and social impacts, including displacement of people and wildlife, changes in water quality, and impacts on aquatic ecosystems. Despite these challenges, hydraulic energy remains an important and widely used source of renewable electricity worldwide (Kuriqi et al., 2021; Rodrigues dos Santos et al., 2021). Solar energy refers to the energy harnessed from the sun's rays. It is a vast, inexhaustible, and clean resource crucial in the global energy landscape. The sun emits a tremendous amount of energy, which reaches the Earth in the form of sunlight. This energy can be captured and converted using various technologies into usable forms, primarily electricity and heat. Solar energy is particularly appealing because it is a clean and renewable energy source, unlike fossil fuels, which emit greenhouse gases and have a finite supply. It can help reduce dependence on fossil fuels, diminish greenhouse gas emissions, and combat climate change. Additionally, solar power systems can provide energy in remote locations not connected to the electricity grid (Ghalandari et al., 2020; Mutezo & Mulopo, 2021; Sharif et al., 2021). Wind energy is a form of renewable energy that harnesses the power of the wind to generate electricity. It is one of the cleanest and most sustainable ways to produce energy, as it does not emit greenhouse gases or pollutants during operation. The basic principle behind wind energy is using wind turbines to convert the kinetic energy of the wind into mechanical power, which can then be converted into electricity. Wind energy is rapidly growing and becoming more cost-competitive with traditional energy sources. It is crucial in reducing carbon emissions and moving towards more sustainable energy systems worldwide (Bento & Fontes, 2019; Zeng et al., 2019). Nuclear energy is a powerful form of energy harnessed from atomic reactions. It is generated through nuclear fission, where the nucleus of an atom, typically uranium or plutonium, is split into smaller parts, releasing a significant amount of energy. This energy is then used to heat water, producing steam that drives turbines to generate electricity. One of the main advantages of nuclear energy is its high energy density; a small amount of nuclear fuel can produce a large amount of energy, making it highly efficient and capable of meeting significant electricity demands. It is also a low-carbon energy source, as the fission process does not emit greenhouse gases, making it an important tool in combating climate change. However, nuclear energy comes with notable challenges and risks. The most significant is the production of radioactive waste, which remains hazardous for thousands of years and requires secure, long-term management. The risk of nuclear accidents, while statistically low, can have severe and long-lasting environmental and health impacts, as evidenced by historical incidents such as

Chornobyl and Fukushima (Caglar, 2023; Ho et al., 2019; S. Wang et al., 2019). This study aims to understand public sentiment towards various forms of energy used in Turkey, focusing on hydroelectric, wind, solar, and the emerging nuclear energy sector. These energy forms were selected due to their relevance and potential in Turkey's energy landscape. Solar, wind, and hydroelectric represent the leading renewable sources after coal and natural gas, signifying a shift towards cleaner energy. Nuclear energy is a focal point due to the upcoming operational status of Turkey's first nuclear power plant, marking a significant development in the country's energy strategy. Figure 1 shows the distribution of daily electricity production according to the most used renewable energy sources on November 18, the day the analysis data was extracted.

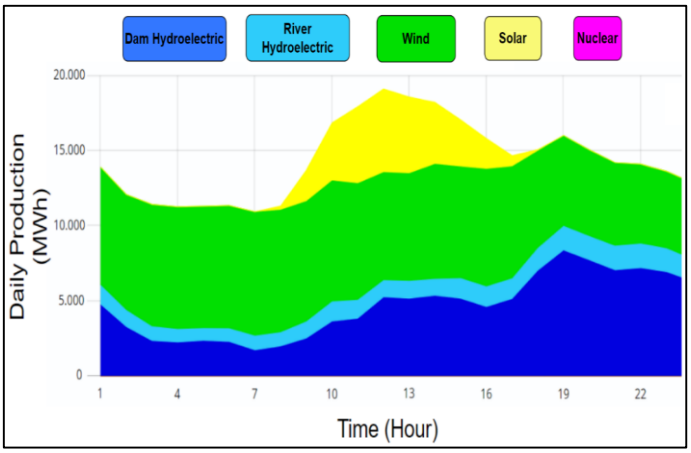

Figure 1. Distribution of Daily Production by Resources as of November 18, 2023 (TEIAS, 2023)

To assess public sentiment towards these four distinct forms of renewable energy, sentiment analysis was performed on a randomly selected sample of 3,269 posts sourced from prominent social media platforms such as Facebook, X, Instagram, Quora, and Reddit. This analysis aimed to gain insights into the prevailing public sentiment associated with hydro, solar, wind, and nuclear energy. By leveraging advanced analytical tools, the study categorizes public opinions extracted from social media content into positive and negative, offering a quantitative and qualitative assessment of public views on each form of energy. This approach provides a comprehensive overview of the public discourse surrounding these energy sources.

By gauging public opinion, this research provides insights into societal perceptions, concerns, and acceptance of these energy forms, thus contributing to a deeper understanding of the public's stance on Turkey's energy mix. By analyzing sentiments expressed on social media platforms regarding four key energy types, this study provides stakeholders, including policymakers, energy companies, and environmental groups, with a nuanced understanding of public opinion on energy sources. Such insights are vital for shaping energy policies, promoting sustainable energy practices, and addressing public concerns about emerging technologies like nuclear power. The outcome of this analysis can offer valuable insights into current public opinions and discussions around these types of renewable energy. Understanding these sentiments can aid businesses, policymakers, and researchers make informed decisions about investments, policy-making, and market strategies in the renewable energy sector. This can contribute to broader research on environmental awareness, policy effectiveness, and the social aspects of transitioning to renewable energy. Insights from sentiment analysis can guide where to direct funding for research and infrastructure development. It can also help predict future trends in renewable energy preferences and acceptance.

2. Literature Review

Sentiment analysis, also known as opinion mining, is a field of natural language processing and artificial intelligence that focuses on identifying and categorizing opinions expressed in a piece of text, primarily to determine whether the writer's attitude towards a particular topic, product or service is positive, negative or neutral. This technique is widely used in various domains to evaluate public opinion, conduct market research, monitor brand and product reputation, and understand customer experiences (Liu, 2022; Soong et al., 2019). Sentiment analysis typically involves processing large amounts of text data to detect emotions like happiness,

anger, sadness, or neutral states. Advanced methods go beyond just positive, negative, or neutral classifications; they can identify specific emotions and even the intensity of these emotions. The process usually involves several steps: data collection, text preprocessing, feature extraction, and finally, applying machine learning or deep learning algorithms to classify the sentiment (Al-Shabi, 2020; Stappen et al., 2023). Regarding social media, sentiment analysis is precious and widely applied. Social media platforms are rich sources of public opinion, as they contain vast amounts of user-generated content, including ideas, thoughts, and feedback on various topics. By analyzing posts, comments, tweets, and other forms of social media communication, businesses and organizations can gain insights into public sentiment about their brand, products, or services (Isnain et al., 2021; Melton et al., 2021; Nemes & Kiss, 2021). This information can inform marketing strategies, product development, customer service approaches, and overall business strategy (Lin et al., 2020). Analyzing social media posts to understand public sentiment towards different forms of renewable energy like hydro, solar, wind, and nuclear is feasible and can provide valuable insights. This process involves sentiment analysis, applied specifically to the context of renewable energy. By examining the tone and content of social media posts, it is possible to evaluate which energy sources are viewed more favorably or unfavorably by the public. This analysis can be particularly revealing as it captures real-time, unfiltered opinions and discussions. Companies in the renewable energy sector can use this information to understand consumer preferences and market trends (Alshamsi et al., 2020; Păvăloaia et al., 2019). This could guide product development, marketing strategies, and investment decisions. For instance, companies might focus more on solar technology development if solar energy is receiving overwhelmingly positive sentiment. Governments and policymakers can use these insights to shape energy policies and public awareness campaigns. Understanding public opinion can help design more widely accepted and supported policies, leading to smoother implementation (Alqaryouti et al., 2020).

The present body of research demonstrates the application of sentiment analysis on diverse social media platforms to comprehend public sentiments and views regarding different forms of renewable energy. This emphasizes the significance of public sentiment in influencing the trajectory of renewable energy in the future. Researchers can use social media sentiment analysis to study public perception of renewable energy over time (M & I, 2022). A range of studies have explored sentiment analysis in the context of renewable energy. Reboredo Ugolini (2018) found that Twitter sentiment had a limited impact on renewable energy stock pricing and trading. In contrast, Jain & Jain (2019) and Kim et al. (2021) used machine learning algorithms to classify Twitter sentiment, achieving high accuracy in their models. Kim et al. (2021) also identified regional variations in sentiment, with the Northeast U.S. showing more positive sentiment toward solar energy. Ibar-Alonso et al. (2022) further analyzed sentiment during the 2022 Ukraine-Russia conflict, finding a shift in sentiment toward green energy. Karaeva et al. (2022) confirmed the dependence between the level of development of nuclear and renewable energy and public attitudes toward them, emphasizing the importance of public sentiment in influencing the development and acceptance of renewable energy sources (Karaeva et al. 2022). These studies collectively highlight the potential of sentiment analysis in understanding public attitudes toward renewable energy. The study conducted by Vespa et al. (2022) employed sentiment analysis on Instagram to get insight into the general sentiments and emotions expressed by the public around renewable energy facilities. The researchers also highlighted the wide range of social media platforms applied for sentiment analysis to capture the various public perspectives surrounding renewable energy. Stigka et al. (2014) reviewed the social acceptance of renewable energy sources, identifying parameters such as education, interest in environmental issues, and knowledge of renewable energy as influencing factors. Olson-Hazboun et al. (2016) further emphasized the importance of framing renewable energy in a way that aligns with local social values, suggesting that factors beyond environmental beliefs influence public support. Ahmad et al. (2014) discovered that attitudes toward renewable energy are mediated by perceived behavioral control and relative advantage, which affect the intention to use such power.

When conducting a sentiment analysis on renewable energy, the attitudes, perceptions, and public opinion regarding renewable energy sources should be considered. Diverse elements affect public opinion on renewable energy, including economic advantages, environmental impacts, and environmental concerns (Olson-Hazboun et al., 2016). In addition, public sentiment toward renewable energy is significantly influenced by public perceptions of the efficacy of policy formulation and planning (Kim et al., 2021). Additionally, various determinants, including consumers' beliefs regarding the advantages of renewable energy, awareness of its

potential, self-efficacy perception, and environmental concern, substantially impact their inclination to embrace such energy sources (Wall et al., 2021).

The level of public support and awareness regarding renewable energy technologies is crucial (Čábelková et al., 2020). Nevertheless, the adoption of renewable energy is impeded by obstacles, including limited public knowledge and cultural resistance, as well as apprehensions regarding the depletion of natural resources and the impact of conventional fuels on climate change (Kaygusuz, 2001). Furthermore, how the media presents renewable energy stories can affect public opinion, as evidenced by how themes and figures regarding renewable energy are given in Nigerian newspapers (Mbamalu, 2020).

Comprehending public sentiments and backing regarding renewable energy is imperative to formulate policies and organize initiatives effectively. The influence of diverse variables, such as economic benefits, environmental concerns, and media framing, on public opinion and attitudes regarding renewable energy sources is indisputable. A comprehensive sentiment analysis must consider these multifaceted influences to comprehensively comprehend public sentiment regarding renewable energy.

3. Material and Method

This study conducted a sentiment analysis to assess public opinion on four types of renewable energy: hydro, solar, wind, and nuclear. This analysis utilized the free web-based tool available at https://app.brandmentions.com (Brandmentions, n.d.), which offers relevant APIs for such assessments. Even in its free version, the tool's capabilities provided substantial data from various social media platforms, including Facebook, X, Instagram, Quora, and Reddit. On 18 November 2023, 3,269 randomly selected posts were extracted using the keywords "hydraulic energy, solar energy, wind energy, and nuclear energy," each type of energy was considered separately to provide a focused and accurate understanding of public sentiment. The use of different social media platforms for the analysis is intentional. Each platform has unique user demographics and interaction styles, which can influence the nature and tone of discussions about renewable energy. A platform like Reddit may exhibit a greater prevalence of professional or technical discussions, while Instagram emphasizes visually driven and personal content.

4. Results and Discussion

Sentiment analysis conducted to evaluate public opinion on renewable energy forms like hydro, solar, wind, and nuclear presents a fascinating snapshot of contemporary social media discourse on these vital topics. Utilizing posts from popular social media applications such as Facebook, Instagram, X, Quora, and Reddit, the analysis searched a significant volume of data despite being limited by the constraints of a free version tool. In total, 3,269 mentions were analyzed, a considerable sample size given the limitations. These mentions generated substantial engagement, evidenced by the 10,598 interactions, 6,600 shares, and 8,500 likes. Such high engagement numbers indicate that discussions around renewable energy are prevalent and trigger strong responses from social media users. Among the 3,269 mentions, there was a significant leaning towards positive sentiment, with 2,012 mentions categorized as positive. This surpasses the 1,257 mentions that were deemed harmful. This move towards positivity suggests a generally favorable public perception of renewable energies on social media platforms. The positive sentiments could be driven by a growing awareness and concern about environmental issues, the perceived benefits of renewable energy in combating climate change, or advancements in renewable energy technologies, making them more appealing. However, many negative sentiments (1,257 mentions) also highlight concerns or skepticism around these energy sources. These could stem from various factors, including economic considerations, technological limitations, perceived unreliability, environmental impact concerns, or even political and ideological beliefs. The data points of shares and likes also contribute to this narrative. The 6,600 shares suggest that the topic resonates strongly enough with users that they are compelled to spread the information within their networks. Similarly, the 8,500 likes indicate a high level of agreement or approval among the audience with the content of the posts. Considering the nature of the platforms used for this analysis is essential. Different platforms serve various discussion types and demographics, which might impact the posts' tone and content. For instance, discussions on Reddit or Quora might search for more detailed and nuanced aspects of renewable energy, while Instagram and Facebook might feature more personal and anecdotal content. This sentiment analysis provides valuable insights into

public perceptions of renewable energy forms. The predominance of positive sentiment suggests a growing public endorsement or interest in renewable energy. However, negative sentiment also underscores the need to address public concerns and provide accurate information to foster a more informed and balanced public discourse on these critical topics. The data is given visually in Figure 2.

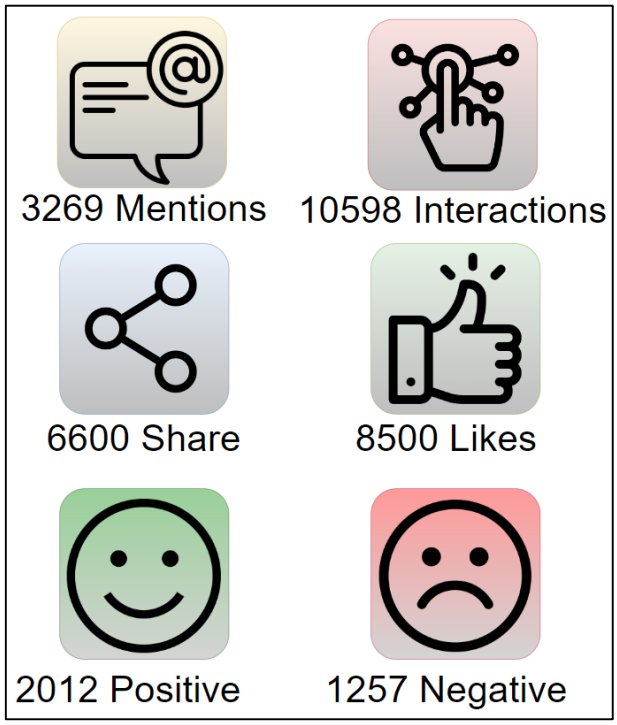

Figure 2. The main findings from the examined mentions

The sentiment analysis to understand public opinions on different forms of renewable energy, such as hydro, solar, wind, and nuclear, provides a rich tapestry of insights, especially considering the distribution of the 3,269 posts across various social media platforms. The breakdown of posts by the platform was as follows: 46% from Quora, 24% from Facebook, 16% from Instagram, 9% from Reddit, and 5% from X. This distribution is quite telling and offers a nuanced understanding of where discussions about renewable energy are most prevalent and perhaps most detailed. Quora, accounting for nearly half of the posts (46%), suggests that a significant portion of the conversation around renewable energy occurs in a context that encourages detailed, informative discussions. Quora is known for its question-and-answer format, which often attracts in-depth, well-thought-out responses. This might indicate that discussions on Quora are more focused on understanding and exploring the complexities of renewable energy, with users seeking or providing detailed insights, opinions, and explanations. Facebook's contribution of 24% of the posts indicates a substantial level of discussion in more personal or community-oriented contexts. Conversations on Facebook can range from individual opinions and experiences to shared news articles and group discussions. The nature of Facebook allows for a blend of personal anecdotes and information dissemination, which could reflect a more diverse range of sentiments and perspectives on renewable energy. As a visually oriented platform, Instagram's 16% share suggests that the discourse here might be centered around visual representations of renewable energy, such as images or videos of solar panels, wind turbines, or hydroelectric plants. Instagram's content might lean towards personal experiences or showcasing aesthetic or practical aspects of renewable energy installations. Making up 9% of the posts, Reddit is known for its community-driven discussions and diverse subreddits. This platform likely hosts a wide range of conversations, from technical discussions in specific subreddits to more general public opinion in broader forums. The nature of Reddit allows for anonymous and open meetings, which can lead to a varied range of views and sentiments being expressed. X, though only representing 5% of the posts, is a platform known for immediacy and brevity. Discussions on X about renewable energy might be more reactive, focusing on current events, news headlines, and succinct opinions. Given its lower percentage, it might suggest

that detailed discussions about renewable energy are less prevalent on X or that the platform's format is less conducive to in-depth sentiment analysis in this context. All data is given in Figure 3.

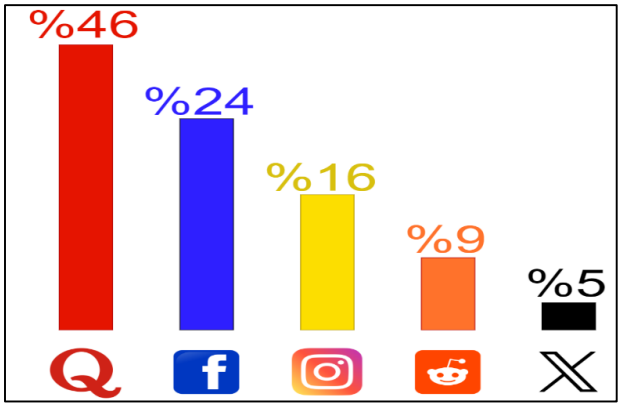

Figure 3. Frequency of Terms on Different Platforms

Figure 4 provides a unique opportunity to compare how the public perceives each energy type, as reflected in social media discussions. The results reveal diverse sentiments, highlighting each energy source's varying acceptance and concerns. Hydro energy emerged with the most favorable sentiment, with an overwhelming 94% of mentions being positive and only 6% negative. This high positivity rate could be attributed to the general perception of hydro energy as a clean, efficient, and reliable renewable energy source. The low environmental impact and the longstanding and proven technology behind hydroelectric power might contribute to its positive image. Solar energy also received a predominantly positive response, with 90% positive mentions and 10% negative. The positivity could be influenced by the widespread promotion of solar energy as a critical solution to climate change, its accessibility at a consumer level (such as solar panels for home use), and the continuous advancements in solar technologies that make it more efficient and affordable. The negative sentiments might stem from concerns over issues like the manufacturing process, disposal of solar panels, or the land use for large solar farms. While still primarily positive, wind energy showed a higher negative sentiment, with 79% positive and 21% negative mentions. The support for wind energy might be due to its role in reducing carbon emissions and its scalability from small wind turbines to large wind farms. However, the negative perceptions could be linked to visual and noise impact concerns, potential effects on wildlife, and the intermittent nature of wind power. Nuclear energy starkly contrasted with the other forms of renewable energy, with 65% negative and 35% positive sentiments. The negative sentiments are likely influenced by public concerns over nuclear safety, radioactive waste management, and the catastrophic potential of nuclear accidents, as history has shown. The positive mentions reflect the recognition of atomic energy as a low-carbon energy source with high energy output and the potential for advanced, safer nuclear technologies in the future.

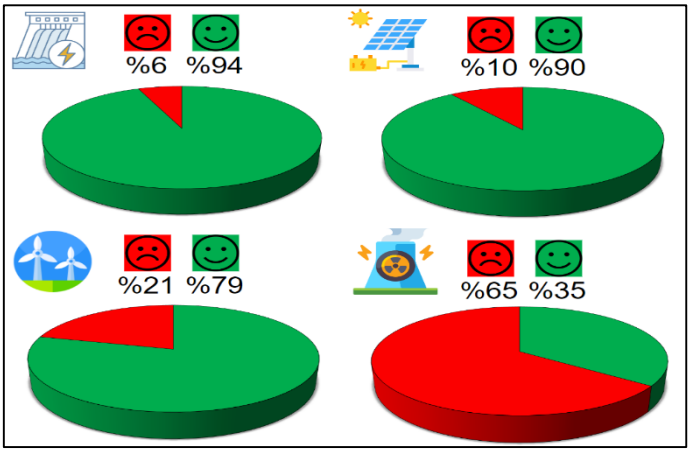

Figure 4. A Sentiment Analysis of Mentions

In Figure 5, sentiment analysis on social media regarding hydro energy reveals a comprehensive array of terms that reflect the public's perception of this renewable energy source. These words, ranging from overwhelmingly positive to cautiously negative, paint a vivid picture of the multifaceted views on hydro energy. At the forefront of the positive sentiments are words like "renewable," "clean," "sustainable," "efficient," "low-emission," "reliable," "abundant," "green," "eco-friendly," and "cost-effective." These terms underscore the general public's recognition of hydro-energy as critical in the renewable energy landscape. The prominence of words like "renewable," "clean," and "sustainable" highlights the widely held view that hydro energy is an essential component of efforts to combat climate change and reduce reliance on fossil fuels. Terms like "efficient" and "low-emission" point to the technical merits of hydro energy in terms of its energy output relative to its environmental footprint. "Reliable" and "abundant" suggest public confidence in the consistent and scalable nature of hydro energy, while "green" and "eco-friendly" reflect the general perception of its environmental benefits. "Cost-effective" indicates an awareness of hydro energy's economic advantages, particularly in the long term. However, the analysis also brings to light a range of concerns associated with hydro energy, as seen in the use of terms like "disruptive," "limited," "inflexible," "destructive," "land-use," "dam failures," "environmental issues," and "flood risks." These words indicate a recognition of the potential negative impacts of hydro energy projects. "Disruptive" and "destructive" could refer to the ecological and social disruptions caused by large-scale hydro projects, such as dam construction. "Limited" and "inflexible" might reflect the understanding that hydro energy, while renewable, is not without its constraints, including geographical and climatic limitations. "Land-use" concerns highlight the significant spatial footprint of hydroelectric dams and reservoirs. "Dam failures" and "flood risks" are particularly telling, pointing to the recognized risks associated with dam infrastructure regarding potential catastrophic failures and the ongoing impact on downstream ecosystems and communities. "Environmental issues" is a broad term that likely encompasses a range of concerns, from the alteration of river ecosystems to the impact on local wildlife and biodiversity. This rich tapestry of words from the sentiment analysis offers valuable insights into the public's nuanced understanding of hydro energy. It reflects a consensus on the benefits of hydro energy as a renewable and clean energy source while also acknowledging the complexities and challenges associated with its implementation and use. For policymakers, industry stakeholders, and environmental advocates, this information is crucial in addressing public concerns, guiding policy and project development, and ensuring that the promotion of hydro energy aligns with broader environmental and social objectives.

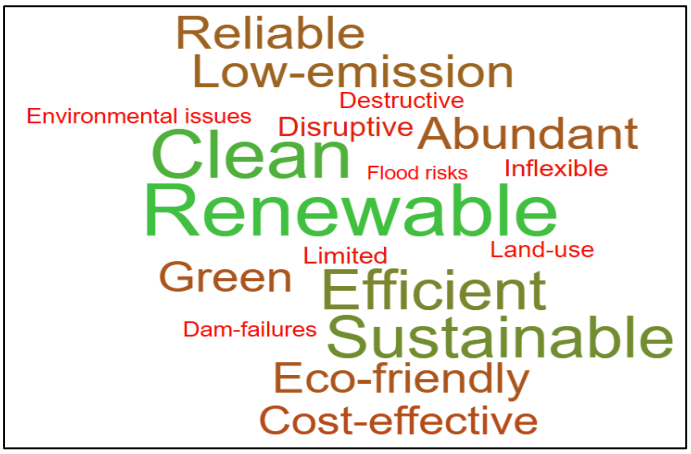

Figure 5. Word cloud analysis on hydro energy according to the mentions

Analyzing social media posts regarding solar energy reveals various terms that capture public sentiment towards this renewable energy source. Figure 6. Leading the positive sentiments are words like "sustainable," "clean," "eco-friendly," "low carbon," "cost-saving," "go green," and "innovative." collectively, these terms underscore a robust public endorsement of solar energy as a critical component in the transition to sustainable and environmentally friendly energy sources. "Sustainable," "clean," and "eco-friendly" reflect the widespread view of solar energy as an essential solution to environmental challenges, particularly climate change. The mention of "low carbon" highlights its role in reducing carbon emissions compared to fossil fuel-based energy sources. "Cost-saving" and "go-green" suggest an awareness of the environmental benefits and the long-term

financial savings associated with solar energy. The word "innovative" captures the cutting-edge nature of solar technology and its continuous evolution. However, the analysis also brings to light several concerns and perceived drawbacks associated with solar energy, as evidenced by terms like "initial costs," "inefficient," "reliance on sunlight," "space-consuming," "manufacturing emissions," "energy storage costs," "weather dependent," "lifespan of panels," "recycling challenges," "aesthetic concerns," and "intermittent." These terms indicate a nuanced understanding of the challenges and limitations of solar energy. "Initial costs" and "energy storage costs" point to the financial aspects that can be barriers to adoption, while "inefficient" and "intermittent" reflect concerns about the dependability of solar energy output, especially in varying weather conditions and during night-time. "Reliance on sunlight" and "weather dependent" further emphasize the influence of environmental factors on the effectiveness of solar energy. "Space-consuming" and "aesthetic concerns" suggest issues with the physical installation of solar panels and their impact on landscapes or building aesthetics. "Manufacturing emissions" and "recycling challenges" highlight the environmental footprint involved in producing and disposing of solar panels, while "lifespan of panels" indicates concerns about durability and long-term performance.

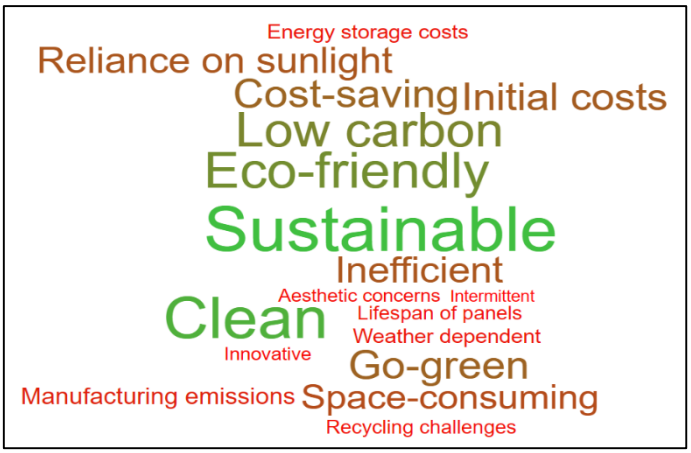

Figure 6. Word cloud analysis on solar energy, according to the mentions

The social media sentiment analysis regarding wind energy provides a rich and nuanced picture of public perception, as seen through the most frequently encountered words in posts. In Figure 7 on the positive side, terms like "sustainable," "clean," "low-emission," "innovative," "scalable," "go-green," "long-term cost-effective," and "abundant" dominate the conversation. These words collectively highlight the public solid endorsement of wind energy as a key player in sustainable and environmentally friendly energy production. "Sustainable," "clean," and "low-emission" underscore the perception of wind energy as a crucial component in reducing greenhouse gas emissions and combating climate change. The word "innovative" reflects the technological advancements and cutting-edge nature of wind energy solutions. "Scalable" and "abundant" point toward the potential for large-scale deployment and the natural abundance of wind as a resource. "Long-term cost-effective" suggests an awareness of the economic benefits, mainly operational costs. However, the analysis also reveals several concerns and perceived drawbacks of wind energy. Terms like "intermittent," "noisy," "visual pollution," "initial investment," "wildlife impacts," "land use," "maintenance challenges," "weather dependent," "unreliable," and "geographically limited" provide insights into the challenges faced by wind energy. "Intermittent" and "weather dependent" reflect concerns about the reliability of wind energy, which can fluctuate based on weather conditions. "noisy" and "visual pollution" point to common criticisms about the impact of wind turbines on local environments and communities. "Initial investment" and "maintenance challenges" highlight the financial and logistical aspects of wind energy projects. The mention of "wildlife impacts" and "land use" indicates concerns about the ecological footprint of wind turbines, particularly on birds and bats, and the spatial requirements for wind farms. "Unreliable" and "geographically limited" suggest limitations in terms of consistent energy production and the dependency on specific geographic locations where wind patterns are favorable.

Figure 7. Word cloud analysis on wind energy, according to the mentions

The sentiment analysis of social media posts about nuclear energy reveals a complex and multifaceted public perception, with a notable focus on concerns and challenges associated with nuclear power. In Figure 8, leading the list of concerns are terms like "radioactive waste," "nuclear accidents," "expensive initial investment," "long-term waste storage," "security risks," "public fear," "water intensive," and references to "Chernobyl" and "Russia." These terms collectively highlight the primary apprehensions surrounding nuclear energy. "Radioactive waste" and "long-term waste storage" underscore the enduring issue of managing the byproducts of nuclear fission, which have remained hazardous for thousands of years. "Nuclear accidents" and specific references to "Chernobyl" resonate with the deep-seated fears stemming from past nuclear disasters, reinforcing the perceived risks of catastrophic events. "Expensive initial investment" points to the high capital costs associated with building nuclear power plants, while "security risks" raise concerns about the potential for nuclear proliferation and terrorist attacks. "Public fear" and "water intensive" further underscore the societal and environmental concerns linked with nuclear power. In this context, mentioning "Russia" might relate to geopolitical issues surrounding nuclear energy, including dependency and international relations concerns. The analysis also brings to light several positive sentiments associated with nuclear power, evidenced by words like "high energy," "low emission," "efficient," "reliable," "advanced technology," "long-lasting fuel," "high power output," "carbon neutral," and "decommissioning costs." These terms suggest an appreciation of the benefits that nuclear energy can offer. "High energy" and "high power output" reflect nuclear power's significant energy generation capacity. At the same time, "low emission" and "carbon neutral" highlight its role in reducing greenhouse gas emissions, a critical factor in combating climate change. "Efficient" and "reliable" point to the consistent and high-output nature of nuclear power generation. "Advanced technology" and "long-lasting fuel" acknowledge the technological advancements in the nuclear sector and the longevity of atomic fuel compared to fossil fuels. "Decommissioning costs," though a challenge, also indicates an awareness of the total lifecycle costs of nuclear power plants.

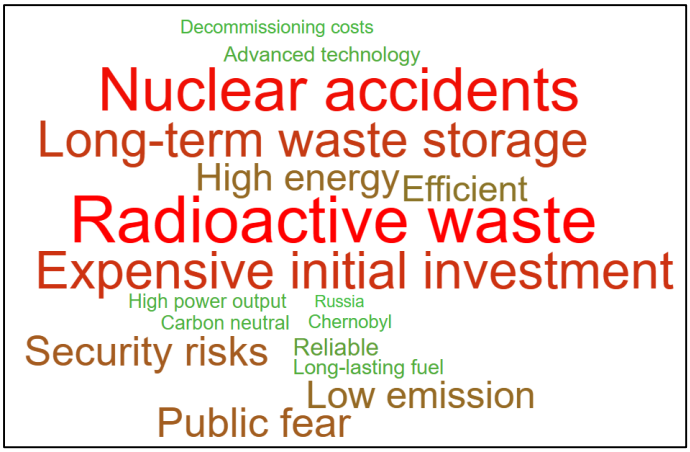

Figure 8. Word cloud analysis on nuclear energy, according to the mentions

While words such as renewable, sustainable, clean, low-emission, sustainable, eco-friendly, and innovative are frequently used for hydro, solar, and wind energy, it is noteworthy that concerns such as radioactive waste, nuclear accidents, and expensive initial investment for nuclear energy stand out among the research findings. The weights of all described data are given in Table 1.

Table 1. Frequency of Data Visualized in the Word Clouds

Hydro Energy		**Solar Energy**		**Wind Energy**		**Nuclear Energy**	
Words	**Freq.**	**Words**	**Freq.**	**Words**	**Freq.**	**Words**	**Freq.**
Renewable	120	Sustainable	115	Sustainable	112	Radioactive waste	132
Clean	111	Clean	110	Clean	106	Nuclear accidents	120
Sustainable	90	Eco-friendly	85	Low-emission	95	Expensive initial investment	99
Efficient	85	Low carbon	80	Innovative	89	Long-term waste storage	91
Low-emission	65	Cost-saving	66	Scalable	60	Security risks	70
Reliable	64	Go-green	65	Go-green	59	Public fear	69
Abundant	60	Initial costs	60	Long-term cost-effective	51	Water intensive	61
Green	56	Inefficient	50	Abundant	46	High energy	54
Eco-friendly	56	Reliance on sunlight	39	Intermittent	35	Low emission	36
Cost-effective	50	Space-consuming	25	Noisy	33	Efficient	33
Disruptive	23	Manufacturing emissions	20	Visual pollution	32	Reliable	29
Limited	15	Energy storage costs	18	Initial investment	25	Advanced technology	25
Inflexible	15	Weather dependent	16	Wildlife Impacts	19	Long-lasting fuel	23
Destructive	13	Lifespan of panels	16	Land use	14	High power output	19
Land-use	12	Recycling challenges	10	Maintenance challenges	14	Carbon neutral	15
Dam-failures	10	Aesthetic concerns	8	Weather dependent	12	Decommissioning costs	14
Environmental issues	9	Innovative	7	Unreliable	8	Chernobyl	9
Flood risks	5	Intermittent	5	Geographical limited	4	Russia	5

Conclusion

This comprehensive sentiment analysis, derived from 3,269 social media mentions across platforms like Facebook, Instagram, X, Quora, and Reddit, offers a multifaceted view of public perception regarding renewable energy forms. The substantial engagement observed, with 10,598 interactions, 6,600 shares, and 8,500 likes, underscores this critical area's high public interest and engagement level. The findings reveal a predominantly positive sentiment towards renewable energy, mainly hydro and solar power, reflecting a growing public consciousness about environmental sustainability and the benefits of these energy sources. Hydro energy, characterized by terms like "renewable," "clean," and "sustainable," is perceived favorably, reflecting its efficiency and low environmental impact. Solar energy, similarly, garners positive responses, highlighting its role in combating climate change and its advancements in technology and accessibility. Conversely, while still viewed positively, wind energy shows higher skepticism, mainly due to concerns about its visual and noise impact and its effect on wildlife. Nuclear power, in contrast, elicits more negative sentiments, primarily driven by fears over safety, waste management, and catastrophic potential, despite recognition of its low-carbon benefits. The platform-specific analysis reveals nuanced insights.

There is a clear need for more informed and balanced discourse, especially addressing misconceptions and concerns about each form of renewable energy. Targeted educational campaigns and transparent communication strategies could help mitigate fears and skepticism, particularly around wind and nuclear fuels. The positive sentiment towards hydro and solar energies should encourage policymakers and industry stakeholders to invest further and promote these forms of renewable energy. Conversely, the concerns around

wind and nuclear power call for a more nuanced approach, addressing environmental and safety issues while highlighting their potential benefits.

Highlighting the general public's growing interest and positive sentiment toward renewable energy, this study draws attention to the existing concerns and areas needing more focused communication and policy intervention. Although this analysis offers a general synopsis, its profundity, and comprehensiveness are constrained by the functionalities accessible solely through the free tier. By providing access to historical data, analyses can be enriched by diversifying the data source. A comprehensive analysis of demographic-specific sentiment and a more nuanced understanding of sentiment trends over time will be possible with this upgrade. Simultaneously, it is imperative to analyze the study's findings while considering the inherent limitations and biases of the analytical tools and data sources. Given the high level of engagement observed, social media platforms can be effectively used for public outreach and education. Each platform's unique demographic and communication style should be considered to tailor messages effectively. Future studies could search how sentiments vary across different demographics and geographical regions, providing more targeted insights for policy and communication strategies. Conducting similar studies would help understand how public perceptions evolve, especially in response to technological advancements, policy changes, and global environmental events. Addressing these concerns and harnessing the power of social media for effective communication, a more informed and supportive public stance toward the transition to sustainable energy sources could be fostered.

Extended Summary

Renewable energy sources have become increasingly vital in the contemporary energy landscape due to their natural replenishment capacity and minimal environmental footprint. This starkly contrasts with finite fossil fuels, which are limited in availability and contribute significantly to environmental degradation by emitting greenhouse gases and pollutants. Renewable energy sources, encompassing solar, wind, hydroelectric, geothermal, and biomass, offer a sustainable and environmentally friendly alternative. These diverse energy forms collectively ensure a reliable, long-term energy supply, effectively addressing the challenges of fossil fuels' finite nature and market volatility. Solar energy is an inexhaustible and pristine resource derived from the sun's rays. Its ability to convert sunlight into electricity and heat is pivotal in global energy. Deploying solar energy significantly diminishes reliance on fossil fuels, especially in remote areas. This, in turn, plays a crucial role in combating climate change, making solar power a linchpin in efforts towards a more sustainable future. Wind energy, another cornerstone of renewable resources, is generated through air movement. It epitomizes cleanliness and sustainability within the energy sector. By converting the kinetic energy of wind into electricity, it stands at the forefront of efforts to reduce carbon emissions. This contributes to more sustainable energy systems and aligns with global efforts to mitigate the adverse effects of climate change. Hydroelectric power, or hydraulic energy, has a long-standing history, having been utilized for centuries. This form of energy, derived from water movement, is renewable and generally regarded as clean. However, it is crucial to acknowledge that the construction of large dams necessary for hydroelectric power generation can lead to significant environmental and social impacts, including ecological disruption and displacement of communities. In the context of low-carbon energy sources, nuclear energy, generated through nuclear fission, is a topic of considerable debate. While it boasts a high energy density and efficiency, making it capable of meeting significant electricity demands, nuclear energy is challenging. The production of radioactive waste and the inherent risks of nuclear accidents remain significant concerns, overshadowing the potential benefits of this energy source. The public's attitude towards renewable energy sources is critical to their adoption and development. Sentiment analysis, a branch of natural language processing and artificial intelligence, offers valuable insights into public opinion on this matter. Using the tool Brandmentions, a sentiment analysis was conducted on November 18, 2023, examining 3,269 social media posts across various platforms, including Facebook, Instagram, Quora, Reddit, and another platform referred to as 'X.' This analysis, which employed keywords associated with different types of energy, revealed intriguing trends in public sentiment. The overarching trend indicated a significant inclination toward positive sentiment regarding renewable energies. This general favorability underscores the public's growing awareness and acceptance of the importance of sustainable energy sources. However, the analysis also revealed a considerable amount of negative sentiment, highlighting areas of concern and skepticism surrounding these energy alternatives. The analysis provided an

enlightening overview of the nature and tone of conversations regarding renewable energy across various social media platforms. Notably, Quora emerged as a key platform for engaging in discussions, with 46% of the posts examined. This forum was distinguished by its penchant for in-depth and informative dialogues, underscoring a widespread desire for a thorough understanding and exploration of renewable energy topics. The discourse here was marked by detailed queries and expert responses, contributing to a rich educational environment. On the other hand, Facebook, constituting 24% of the posts analyzed, presented a varied landscape of discussions. This platform hosted many perspectives, ranging from personal anecdotes and experiences to more collective dialogues in groups alongside shared news articles. Such diversity offered a more rounded and multifaceted view of the subject, encapsulating individual and communal sentiments. Instagram, accounting for 16% of the discussions, showcased content predominantly revolving around personal experiences and the aesthetic dimensions of renewable energy. Given Instagram's visual-centric nature, it is no surprise that posts often emphasize the visual appeal of renewable technologies, from solar panels to wind turbines, framing them in a more personal and lifestyle-oriented context. Reddit, contributing 9% to the overall discourse, fostered a blend of technical discussions and public opinions across its various subreddits. The nature of conversations on Reddit indicated a community-driven approach, where enthusiasts, experts, and laypersons alike engaged in detailed technical discussions, offering a more grassroots perspective on renewable energy topics. The remaining 5% of posts, categorized under 'X,' appeared to focus on more immediate, concise, and perhaps pragmatic discussions about renewable energy. This platform seemed to attract a segment of the audience interested in straightforward, to-the-point dialogues without the in-depth analyses found in forums like Quora or the personal narratives prevalent on Instagram. Moreover, the sentiment analysis conducted as part of this study shed light on public perceptions regarding specific types of renewable energy. Hydro Energy emerged with a 94% positivity rate and is widely recognized for its cleanliness and reliability. However, there was also a palpable undercurrent of concern regarding its environmental and social impacts, reflecting a nuanced understanding among the public. Solar Energy was met with 90% positive mentions and celebrated for its significant role in combating climate change and its ongoing technological advancements. However, reservations about the manufacturing processes and land use implications were expressed, indicating a critical engagement with the subject. Wind Energy received a 79% positive sentiment, praised for its scalability and essential role in reducing emissions. Despite this support, it faced criticism for potential visual and noise pollution and its effects on wildlife, reflecting a complex balance of benefits and drawbacks. In stark contrast, Nuclear Energy had a predominance of negative sentiment, with 65% expressing concerns. The apprehension largely stemmed from issues related to safety, the management of radioactive waste, and the historical context of nuclear accidents, highlighting deep-rooted concerns in public perception. In conclusion, the analysis underscored the vital role of renewable energy sources in fostering environmental sustainability and economic growth. The diverse nature of public engagement with these topics, as revealed by the sentiment analysis across different social media platforms, underscored the multifaceted nature of public opinion in this domain. These insights are invaluable for stakeholders in the renewable energy sector, providing essential guidance for informed decision-making and strategic development toward a cleaner, more sustainable future.

References

Ahmad, A., Rashid, M., Omar, N. A., & Alam, S. S. (2014). Perceptions on Renewable Energy Use in Malaysia: Mediating Role of Attitude. *Journal Pengurusan*, 41, 123–131.

Alqaryouti, O., Siyam, N., Abdel Monem, A., & Shaalan, K. (2020). Aspect-Based Sentiment Analysis using Smart Government Review Data. *Applied Computing and Informatics*, DOI/10.1016/j.aci.2019.11.003.

Al-Shabi, M. (2020). Evaluating the Performance of the Most Important Lexicons Used for Sentiment Analysis and Opinions. *Mining*. 20, 1.

Alshamsi, A., Bayari, R., & Salloum, S. (2020). Sentiment Analysis in English Texts. *Advances in Science, Technology and Engineering Systems Journal*, 5, (6), 1683-1689.

Barone, G., Buonomano, A., Forzano, C., Giuzio, G. F., & Palombo, A. (2021). Increasing Renewable Energy Penetration and Energy Independence of Island Communities: A Novel Dynamic Simulation Approach for Energy, Economic, and Environmental Analysis, and Optimization. *Journal of Cleaner Production*, 311, 127558, https://doi.org/10.1016/j.jclepro.2021.127558.

Bento, N., & Fontes, M. (2019). Emergence of Floating Offshore Wind Energy: Technology and Industry. *Renewable and Sustainable Energy Reviews*, 99, 66–82.

Bilgili, F., Lorente, D. B., Kuşkaya, S., Ünlü, F., Gençoğlu, P., & Rosha, P. (2021). The Role of Hydropower Energy in the Level of CO_2 Emissions: An Application of Continuous Wavelet Transform. *Renewable Energy*, 178, 283–294.

Brandmentions. (n.d.). BrandMentions | Upgrade the way You Monitor Your Brand Competitors. https://brandmentions.com/

Čábelková, I., Strielkowski, W., Firsova, I., & Korovushkina, M. (2020). Public Acceptance of Renewable Energy Sources: A Case Study from the Czech Republic. *Energies*, 13, (7), DOI/10.3390/en13071742.

Caglar, A. E. (2023). Can Nuclear Energy Technology Budgets Pave the Way for a Transition Toward Low-Carbon Economy: Insights from the United Kingdom. *Sustainable Development*, 31, (1), 198–210.

Chen, X. H., Tee, K., Elnahass, M., & Ahmed, R. (2023). Assessing the Environmental Impacts of Renewable Energy Sources: A Case Study on Air Pollution and Carbon Emissions in China. *Journal of Environmental Management*, 345, 118525, DOI/10.1016/j.jenvman.2023.118525.

Chien, F., Ajaz, T., Andlib, Z., Chau, K. Y., Ahmad, P., & Sharif, A. (2021). The Role of Technology Innovation, Renewable Energy, and Globalization in Reducing Environmental Degradation in Pakistan: A Step towards a Sustainable Environment. *Renewable Energy*, 177, 308–317.

Ghalandari, M., Maleki, A., Haghighi, A., Safdari Shadloo, M., Alhuyi Nazari, M., & Tlili, I. (2020). Applications of Nanofluids Containing Carbon Nanotubes in Solar Energy Systems: A Review. *Journal of Molecular Liquids*, 313, 113476, DOI/10.1016/j.molliq.2020.113476.

Haldar, A., & Sethi, N. (2022). Environmental Effects of Information and Communication Technology—Exploring the Roles of Renewable Energy, Innovation, Trade and Financial Development. *Renewable and Sustainable Energy Reviews*, 153, 111754, DOI/10.1016/j.rser.2021.111754.

Ho, S. S., Leong, A. D., Looi, J., Chen, L., Pang, N., & Tandoc, E. (2019). Science Literacy or Value Predisposition? A Meta-Analysis of Factors Predicting Public Perceptions of Benefits, Risks, and Acceptance of Nuclear Energy. *Environmental Communication*, 13, (4), 457–471.

Ibar-Alonso, R., Quiroga-García, R., & Arenas-Parra, M. (2022). Opinion Mining of Green Energy Sentiment: A Russia-Ukraine Conflict Analysis. *Mathematics*, 10, (14), DOI/10.3390/math10142532.

Isnain, A. R., Supriyanto, J., & Kharisma, M. P. (2021). Implementation of K-Nearest Neighbor (K-NN) Algorithm for Public Sentiment Analysis of Online Learning. *IJCCS (Indonesian Journal of Computing and Cybernetics Systems)*, 15, (2), 121-130.

Jain, A., & Jain, V. (2019). Sentiment classification of Twitter Data Belonging to Renewable Energy using Machine Learning. *Journal of Information and Optimization Sciences*, 40, (2), 521–533.

Karaeva, A., Magaril, E., Torretta, V., Viotti, P., & Rada, E. C. (2022). Public Attitude towards Nuclear and Renewable Energy as a Factor of Their Development in a Circular Economy Frame: Two Case Studies. *Sustainability*, 14, (3), DOI/10.3390/su14031283.

Kaygusuz, K. (2001). Renewable Energy: Power for a Sustainable Future. *Energy Exploration & Exploitation*, 19, (6), 603–626.

Kim, S. Y., Ganesan, K., Dickens, P., & Panda, S. (2021). Public Sentiment toward Solar Energy—Opinion Mining of Twitter Using a Transformer-Based Language Model. *Sustainability*, 13, (5), DOI/10.3390/su13052673

Kuriqi, A., Pinheiro, A. N., Sordo-Ward, A., Bejarano, M. D., & Garrote, L. (2021). Ecological Impacts of Run-of-River Hydropower Plants—Current Status and Future Prospects on the Brink of Energy Transition. *Renewable and Sustainable Energy Reviews*, 142, 110833, DOI/10.1016/j.rser.2021.110833.

Li, G., Li, M., Taylor, R., Hao, Y., Besagni, G., & Markides, C. N. (2022). Solar Energy Utilization: Current Status and Roll-Out Potential. *Applied Thermal Engineering*, 209, 118285, DOI/10.1016/j.applthermaleng.2022.118285.

Liang, Y., Ji, X., Wu, C., He, J., & Qin, Z. (2020). Estimation of the Influences of Air Density on Wind Energy Assessment: A Case Study from China. *Energy Conversion and Management*, 224, 113371, DOI/10.1016/j.enconman.2020.113371.

Lin, H.-C. K., Wang, T.-H., Lin, G.-C., Cheng, S.-C., Chen, H.-R., & Huang, Y.-M. (2020). Applying Sentiment Analysis to Classify Consumer Comments Concerning Marketing 4Cs Aspects Automatically. *Applied Soft Computing*, 97, 106755, DOI/10.1016/j.asoc.2020.106755.

Liu, B. (2022). Sentiment Analysis and Opinion Mining. *Springer Nature*, 1-21.

Lund, J. W., & Toth, A. N. (2021). Direct Utilization of Geothermal Energy 2020 Worldwide Review. *Geothermics*, 90, 101915, DOI/10.1016/j.geothermics.2020.101915.

M, A. J., & I, E. S. (2022). Role of Educational Data Mining in Student Learning Processes with Sentiment Analysis: A Survey. *In Research Anthology on Interventions in Student Behavior and Misconduct*, (16), 412–427.

Mahmood, N., Wang, Z., & Hassan, S. T. (2019). Renewable Energy, Economic Growth, Human Capital, and CO_2 Emission: An Empirical Analysis. *Environmental Science and Pollution Research*, 26, (20), 20619–20630.

Mbamalu, M. (2020). Newspaper Coverage of Renewable Energy in Nigeria: Frames, Themes, and Actors. *SAGE Open*, 10, (2), DOI/10.1177/215824402092619.

Melton, C. A., Olusanya, O. A., Ammar, N., & Shaban-Nejad, A. (2021). Public Sentiment Analysis and Topic Modeling Regarding COVID-19 Vaccines on the Reddit Social Media Platform: A Call to Action for Strengthening Vaccine Confidence. *Journal of Infection and Public Health*, 14, (10), 1505–1512.

Mutezo, G., & Mulopo, J. (2021). A Review of Africa's Transition from Fossil Fuels to Renewable Energy using Circular Economy Principles. *Renewable and Sustainable Energy Reviews*, 137, 110609, DOI/10.1016/j.rser.2020.110609.

Nemes, L., & Kiss, A. (2021). Social Media Sentiment Analysis Based on COVID-19. *Journal of Information and Telecommunication*, 5, (1), 1–15.

Olabi, A. G., & Abdelkareem, M. A. (2022). Renewable Energy and Climate Change. *Renewable and Sustainable Energy Reviews*, 158, 112111, DOI/10.1016/j.rser.2022.112111.

Oliveira, A. M., Beswick, R. R., & Yan, Y. (2021). A Green Hydrogen Economy for a Renewable Energy Society. *Current Opinion in Chemical Engineering*, 33, 100701, DOI/10.1016/j.coche.2021.100701.

Olson-Hazboun, S. K., Krannich, R. S., & Robertson, P. G. (2016). Public Views on Renewable Energy in the Rocky Mountain Region of the United States: Distinct Attitudes, Exposure, and Other Key Predictors of Wind Energy. *Energy Research & Social Science*, 21, 167–179.

Păvăloaia, V.-D., Teodor, E.-M., Fotache, D., & Danileț, M. (2019). Opinion Mining on Social Media Data: Sentiment Analysis of User Preferences. *Sustainability*, 11, (16), DOI/10.3390/su11164459

Ram, M., Aghahosseini, A., & Breyer, C. (2020). Job Creation during the Global Energy Transition towards a 100% Renewable Power System by 2050. *Technological Forecasting and Social Change*, 151, 119682, DOI/10.1016/j.techfore.2019.06.008.

Razmjoo, A., Gakenia Kaigutha, L., Vaziri Rad, M. A., Marzband, M., Davarpanah, A., & Denai, M. (2021). A Technical Analysis Investigating Energy Sustainability Utilizing Reliable Renewable Energy Sources to Reduce CO_2 Emissions in a High Potential Area. *Renewable Energy*, 164, 46–57.

Reboredo, J. C., & Ugolini, A. (2018). The Impact of Twitter Sentiment on Renewable Energy Stocks. *Energy Economics*, 76, 153–169.

Rodrigues dos Santos, E., Michalski, F., & Norris, D. (2021). Understanding Hydropower Impacts on Amazonian Wildlife is Limited by a Lack of Robust Evidence: Results from a Systematic Review. *Tropical Conservation Science*, 14, DOI/10.1177/19400829211045788.

Sharif, A., Meo, M. S., Chowdhury, M. A. F., & Sohag, K. (2021). Role of Solar Energy in Reducing Ecological Footprints: An Empirical Analysis. *Journal of Cleaner Production*, 292, 126028, DOI/10.1016/j.jclepro.2021.126028.

Soong, H.-C., Jalil, N. B. A., Kumar Ayyasamy, R., & Akbar, R. (2019). The Essential of Sentiment Analysis and Opinion Mining in Social Media: Introduction and Survey of the Recent Approaches and Techniques. *2019 IEEE 9th Symposium on Computer Applications & Industrial Electronics (ISCAIE)*, 272–277.

Stappen, L., Baird, A., Schumann, L., & Schuller, B. (2023). The Multimodal Sentiment Analysis in Car Reviews (MuSe-CaR) Dataset: Collection, Insights and Improvements. *IEEE Transactions on Affective Computing*, 14, (2), 1334–1350.

Stigka, E. K., Paravantis, J. A., & Mihalakakou, G. K. (2014). Social Acceptance of Renewable Energy Sources: A Review of Contingent Valuation Applications. *Renewable and Sustainable Energy Reviews*, 32, 100–106.

Teias. (2023). Türkiye Electricity Statistics. Load Dispatch Information System. https://ytbsbilgi.teias.gov.tr/ytbsbilgi/frm_istatistikler.jsf

Uddin, W., Ayesha, Zeb, K., Haider, A., Khan, B., Islam, S. ul, Ishfaq, M., Khan, I., Adil, M., & Kim, H. J. (2019). Current and Future Prospects of Small Hydro Power in Pakistan: A Survey. *Energy Strategy Reviews*, 24, 166–177.

Vespa, M., Kortsch, T., Hildebrand, J., Schweizer-Ries, P., & Volkmer, S. A. (2022). Not All Places Are Equal: Using Instagram to Understand Cognitions and Affect towards Renewable Energy Infrastructures. *Sustainability*, 14, (7), DOI/10.3390/su14074071.

Viviescas, C., Lima, L., Diuana, F. A., Vasquez, E., Ludovique, C., Silva, G. N., Huback, V., Magalar, L., Szklo, A., Lucena, A. F. P., Schaeffer, R., & Paredes, J. R. (2019). Contribution of Variable Renewable Energy to Increase Energy Security in Latin America: Complementarity and Climate Change Impacts on Wind and Solar Resources. *Renewable and Sustainable Energy Reviews*, 113, 109232,

DOI/10.1016/j.rser.2019.06.039.

Wall, W. P., Khalid, B., Urbański, M., & Kot, M. (2021). Factors Influencing Consumer's Adoption of Renewable Energy. *Energies*, 14, (17), DOI/10.3390/en14175420.

Wang, G., Sadiq, M., Bashir, T., Jain, V., Ali, S. A., & Shabbir, M. S. (2022). The Dynamic Association between Different Strategies of Renewable Energy Sources and Sustainable Economic Growth under SDGs. *Energy Strategy Reviews*, 42, 100886, DOI/10.1016/j.esr.2022.100886.

Wang, M., Wang, G., Sun, Z., Zhang, Y., & Xu, D. (2019). Review of Renewable Energy-Based Hydrogen Production Processes for Sustainable Energy Innovation. *Global Energy Interconnection*, 2, (5), 436–443.

Wang, S., Wang, J., Lin, S., & Li, J. (2019). Public Perceptions and Acceptance of Nuclear Energy in China: The Role of Public Knowledge, Perceived Benefit, Perceived Risk, and Public Engagement. *Energy Policy*, 126, 352–360.

Zeng, Z., Ziegler, A. D., Searchinger, T., Yang, L., Chen, A., Ju, K., Piao, S., Li, L. Z. X., Ciais, P., Chen, D., Liu, J., Azorin-Molina, C., Chappell, A., Medvigy, D., & Wood, E. F. (2019). A Reversal in Global Terrestrial Stilling and Its Implications for Wind Energy Production. *Nature Climate Change*, 9, (12), 979-985.

Etik, Beyan ve Açıklamalar

1. Etik Kurul izni ile ilgili;

☑ Bu çalışmanın yazar/yazarları, Etik Kurul İznine gerek olmadığını beyan etmektedir.

2. Bu çalışmanın yazar/yazarları, araştırma ve yayın etiği ilkelerine uyduklarını kabul etmektedir.

3. Bu çalışmanın yazar/yazarları kullanmış oldukları resim, şekil, fotoğraf ve benzeri belgelerin kullanımında tüm sorumlulukları kabul etmektedir.

4. Bu çalışmanın benzerlik raporu bulunmaktadır.