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# Literature review on the intention to purchase voluntary carbon offsets

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**Abstract**
Amid growing pressure from climate change, voluntary carbon offset contributions are becoming a crucial solution for individuals and businesses to reduce their carbon footprint. The motivation to purchase these offsets goes beyond environmental awareness, being influenced by social responsibility, sustainable consumer psychology, as well as economic and policy factors. This study offers a comprehensive and in-depth analysis of the intention to purchase voluntary carbon offsets, marking the first such review. Using bibliometric methods and VOSviewer software, the study evaluates 152 publications from Scopus (2007-2024). The findings reveal that major countries like the UK, the US, Germany, and Australia impact both carbon credit policies and global consumer behavior. The study also identifies research gaps and suggests future directions for exploring the topic of voluntary carbon offset purchase intentions.

**Keywords:** Literature review, voluntary carbon offset, VOSviewer, intention

## Introduction

In the context of global challenges posed by climate change, the concept of 'carbon neutrality' has become an important goal for many countries, organizations, and businesses. Specifically, the purchase of voluntary carbon offset contributions, also known as carbon credits, plays a crucial role in efforts to mitigate the impact of climate change. According to a study by Warburg *et al.* (2021) [25] published in the journal Business Strategy and the Environment, consumers are encouraged to reduce greenhouse gas emissions from certain activities, and if emissions cannot be avoided, they can purchase voluntary carbon offsets (Warburg và c.s., 2021) [25]. VCO providers claim that this approach allows customers to reduce their ecological footprint.

Purchasing voluntary carbon offset contributions is an effective solution that enables individuals, organizations, or businesses to compensate for their greenhouse gas emissions by funding projects that reduce or eliminate greenhouse gases, such as reforestation, renewable energy development, or energy efficiency improvements. According to the Taskforce on Scaling Voluntary Carbon Markets (TSVCM), voluntary carbon markets play a crucial role in supporting the achievement of global Net Zero targets, especially as government resources and mandatory mechanisms remain limited.

While numerous studies have been conducted on innovations in voluntary carbon neutrality, research on the intention to purchase voluntary carbon offsets is still limited. This study provides a comprehensive and in-depth overview of the intention to purchase voluntary carbon offset contributions. Based on 157 documents from the Scopus database, the study shows that research on this relationship first appeared in 2007, and this trend has increasingly attracted scholarly attention up to the present. By analyzing bibliometric indicators using VOSviewer software, the study illustrates the most influential articles, book chapters, books, and conference proceedings, as well as the most cited documents, authors, and countries. Additionally, the study presents co-citation analysis to predict future research trends.

Research on the intention to purchase voluntary carbon offsets offers valuable insights for researchers: (1) it provides an overview of sustainable consumer behavior, helping to better understand the factors that drive or hinder the intention to purchase carbon-neutral products

or services, and (2) it offers a comprehensive review of the topics within the research field, serving as a reference for future studies in this area.

**Materials and Methods**

Voluntary Carbon Offsetting (VCO) is a mechanism for the trading of carbon credits by businesses, organizations, and individuals on a voluntary basis to offset their greenhouse gas emissions, instead of being required to comply with legal regulations. Voluntary Carbon Offsetting (VCO) operates within the voluntary carbon market (VCM), where businesses, organizations, and individuals, who are not legally obligated to follow regulations, participate in offsetting emissions to achieve carbon neutrality (net zero) or corporate social responsibility (CSR) goals. This is different from compliance systems, such as the European Union Emissions Trading System (EU ETS) or the Clean Development Mechanism (CDM) under the Kyoto Protocol.

Since the Paris Agreement (2015), Voluntary Carbon Offsetting (VCO) has grown rapidly, with independent standards such as the Verified Carbon Standard (VCS - Verra), Gold Standard, and American Carbon Registry (ACR) playing a central role in carbon credit verification.

The data source for this study was obtained from 'Scopus,' using a method of retrieving studies from 2007 onwards. According to Falagas *et al.* (2008), 'Scopus' has a coverage rate about 20% higher than 'Web of Science' to compensate for the research gap from before 2007. Additionally, Zhu and Liu (2020) [26] found that these two databases share a significant number of documents, and 'Scopus' is more frequently used than 'Web of Science.' The research results show that in the social sciences, the overlap between the two databases is substantial (34%). According to Phung and Nguyen (2023), [27] 'Scopus' has 64% exclusive data, while 'Web of Science' has only 2%. Based on this, the authors chose Scopus as the primary database for this study. The search was conducted using the syntax: TITLE-ABSTRACT-KEYWORDS ("voluntary" and "carbon" and "offsetting"). The dataset documents were carefully filtered through a data screening process to exclude irrelevant studies before analysis. The resulting dataset was adjusted following PRISMA guidelines and OpenRefine, leading to the selection of 157 papers on voluntary carbon emergence and its relation to carbon offsetting. These documents were then analyzed to provide an overview of the research field and future research trends.

Out of the 157 documents, the authors reviewed and excluded 5 that were not relevant to the intention to purchase voluntary carbon offset contributions, leaving 152 documents for bibliometric analysis. The authors extracted the text data files containing useful information about each publication, such as the title, author(s), abstract, language, and year of publication. The collected articles were in line with the research analysis criteria and were saved into two file types: research information system (.ris) and comma-separated values (*.csv). The data collection process followed PRISMA guidelines (Haddaway, Page, Pritchard, & McGuinness, 2022).

The dataset includes 152 published scientific works, of which 117 are journal articles (76.97%), 3 books (1.97%), 15 book chapters (9.86%), 8 conference papers (5.26%), 7 review articles (4.6%), 1 short survey (0.66%), and 1 note (0.66%). All publications are in English (150 items, 98.68%), with 1 in German (0.66%) and 1 in Russian (0.66%). The results in Figure 3.2.1 show that in 2007, researchers began to recognize the need for research on the emergence of voluntary carbon and its relationship to voluntary carbon offsetting, with studies by Gössling, Stefan; Broderick, John; Upham, Paul; Ceron, Jean-Paul; Dubois, Ghislain; Peeters, Paul; Strasdas, Wolfgang (2007) [9], Venables, M. (2007) [28], and Simon, S.J., Singleton, A.R., Carter, J.F. (2007) [29]. After that, only a few studies were published. However, from 2014, the research trend started to increase gradually (10 publications) up to 2024 (22 publications). Of the total 152 publications, 47 are quantitative studies (30.92%), 78 are qualitative studies (51.31%), and 27 are mixed-method studies (17.76%). The expansion of research from 2014 to 2024 shows a growing interest among researchers in the topic of voluntary carbon offset contribution purchase intention.

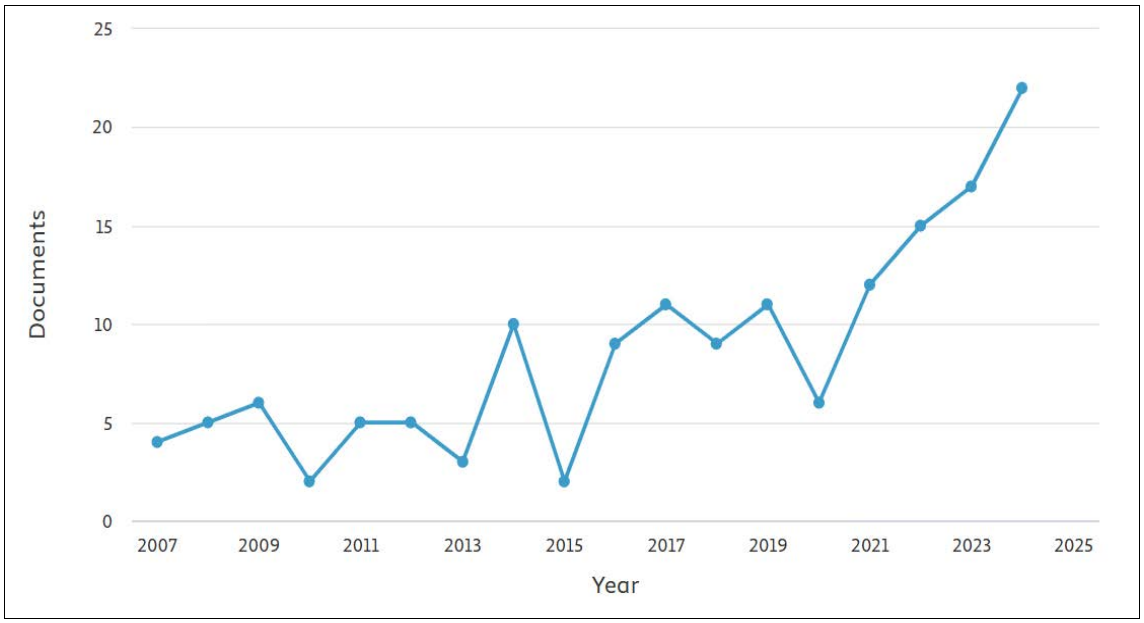


**Fig 1:** The number of research publications over the years from 2007-2024

## Results and Discussion

**Table 1:** Top 5 most cited research papers

| Research Title | Number of Citations |
|---|---|
| Voluntary Carbon Offsetting Schemes for Aviation: Efficiency, Credibility and Sustainable Tourism (Gössling *et al.*, 2007) [9] | 229 |
| Blue Growth Potential to Mitigate Climate Change through Seaweed Offsetting (Froehlich *et al.*, 2019) [8] | 195 |
| Virtual nature, violent accumulation: The "spectacular failure" of carbon offsetting at a Ugandan National Park (Cavanagh & Benjaminsen, 2014) [4, 18] | 183 |
| Exploring air travellers' voluntary carbon-offsetting behaviour (Mair, 2011) [16] | 168 |
| Swedish air travellers and voluntary carbon offsets: Towards the co-creation of environmental value? (Gössling *et al.*, 2009) [10] | 157 |

Table 1 shows the top 5 publications with the most citations, as follows: The most cited study is the article "Voluntary Carbon Offsetting Schemes for Aviation: Efficiency, Credibility and Sustainable Tourism" by Stefan Gössling *et al.* (2007) [9], with 229 citations. This study focuses on examining questions about the obligation to reduce greenhouse gas (GHG) emissions under the Kyoto Protocol and the post-Kyoto documents, while also considering additional issues arising from the increasing number of organizations offering voluntary carbon offsets. The results show that these organizations have significantly different approaches when choosing carbon offset measures, calculating emissions, setting prices, evaluating processes, and company structures.

The second most cited study is "Blue Growth Potential to Mitigate Climate Change through Seaweed Offsetting" by Halley E. Froehlich *et al.* (2019) [8], with 195 citations. This study seeks to provide sufficient CO2eq removal for several climate change mitigation models, focusing on the food sector as a major source of greenhouse gases by evaluating the scale and cost of seaweed cultivation expansion. The study argues that contributing to climate change mitigation through seaweed offsets for global agriculture would be extremely difficult, even with a much larger scale, partly due to production growth and cost constraints. However, it would be more feasible at a regional level, especially in areas with strong climate policies.

The third most cited study is "Virtual nature, violent accumulation: The "spectacular failure" of carbon offsetting at a Ugandan National Park" by Cavanagh, C., *et al.* (2014) [4], with 183 citations. This study found that in East Africa, despite difficulties, conservationists and governments still view voluntary carbon offset programs as beneficial. The study analyzes the progress and setbacks of an integrated carbon offset and conservation initiative at Mount Elgon National Park in Eastern Uganda, closely tied to the partnership between the Uganda Wildlife Authority (UWA) and Face the Future, a Dutch NGO. The results show that contrary to the conservationists' and governments' views, it is a "spectacular failure," highlighted by two issues. The first is the complete collapse of the powerful media images of harmonious and profitable conservation. The second is the damaging consequences suffered by local communities and the entire ecosystem.

The fourth most cited study is "Exploring air travellers' voluntary carbon-offsetting behaviour" by Mair, J. (2011) [16], with 168 citations. This study aims to raise consumer awareness regarding voluntary carbon offset purchases for flights, examining whether those who buy carbon offsets (VCO) are ecologists and whether they share similar demographic profiles with individuals engaged in other environmentally friendly behaviors. The study's results show that VCO buyers are not necessarily ecologists and that those who purchase VCOs have a different demographic profile compared to individuals participating in other eco-friendly behaviors. Furthermore, the study suggests that this airline passenger segment was already willing to contribute to climate change mitigation.

The fifth most cited study is "Swedish air travellers and voluntary carbon offsets: Towards the co-creation of environmental value?" by Gössling, S. *et al.* (2009) [9]. This study aims to analyze the role of voluntary carbon offset programs as a tool to mitigate airline carbon emissions, while also examining the level of understanding and attitudes of airline passengers toward this program. The study's results show that voluntary carbon offsetting could be an interesting means of co-creating environmental value and reducing the environmental load of the airline industry. However, it should not become a tool to justify further growth of the aviation industry.

Figure 2 displays the names, number of works, and reader interest in the publications of the top five most cited authors in this research field. The author with the highest recognition is Stefan Gössling, with 502 citations across 5 publications, including 2 works that are in the top 5 most cited in Figure 2. His research focuses on the implementation and participation behavior in voluntary carbon offset programs in the aviation industry. The second most cited author is Brent W. Ritchie, with 383 citations across 9 publications. His research examines the impact of voluntary carbon offset policies on the aviation industry and passengers' voluntary carbon offset purchasing behavior. The third most cited author is Judith Mair, with 260 citations and 4 publications. Similar to the previous authors, Mair focuses on issues related to voluntary carbon offsetting in aviation. The fourth and fifth most cited authors are Diana Liverman and Heather Lovell, with 242 citations and 2 collaborative publications. They focus on theories of ethical and sustainable consumption in the voluntary carbon market, as well as exploring technological techniques for generating carbon credit.

**Verify selected authors**

| Selected | Author | Documents | Citations | Total link strength |
|---|---|---|---|---|
| ☑ | gŏssling, stefan | 5 | 502 | 15 |
| ☑ | ritchie, brent w. | 6 | 291 | 11 |
| ☑ | mair, judith | 4 | 260 | 9 |
| ☑ | liverman, diana | 2 | 242 | 3 |
| ☑ | lovell, heather | 2 | 242 | 3 |
| ☑ | broderick, john | 2 | 240 | 6 |
| ☑ | ceron, jean-paul | 1 | 229 | 6 |
| ☑ | dubois, ghislain | 1 | 229 | 6 |
| ☑ | peeters, paul | 1 | 229 | 6 |
| ☑ | strasdas, wolfgang | 1 | 229 | 6 |
| ☑ | upham, paul | 1 | 229 | 6 |
| ☑ | afflerbach, jamie c. | 1 | 192 | 3 |
| ☑ | frazier, melanie | 1 | 192 | 3 |
| ☑ | froehlich, halley e. | 1 | 192 | 3 |
| ☑ | halpern, benjamin s. | 1 | 192 | 3 |
| ☑ | benjaminsen, tor a. | 1 | 183 | 1 |
| ☑ | cavanagh, connor | 1 | 183 | 1 |
| ☑ | haglund, louise | 1 | 157 | 4 |
| ☑ | hultman, johan | 1 | 157 | 4 |

**Fig 2:** Number of Articles and Citations by Authors

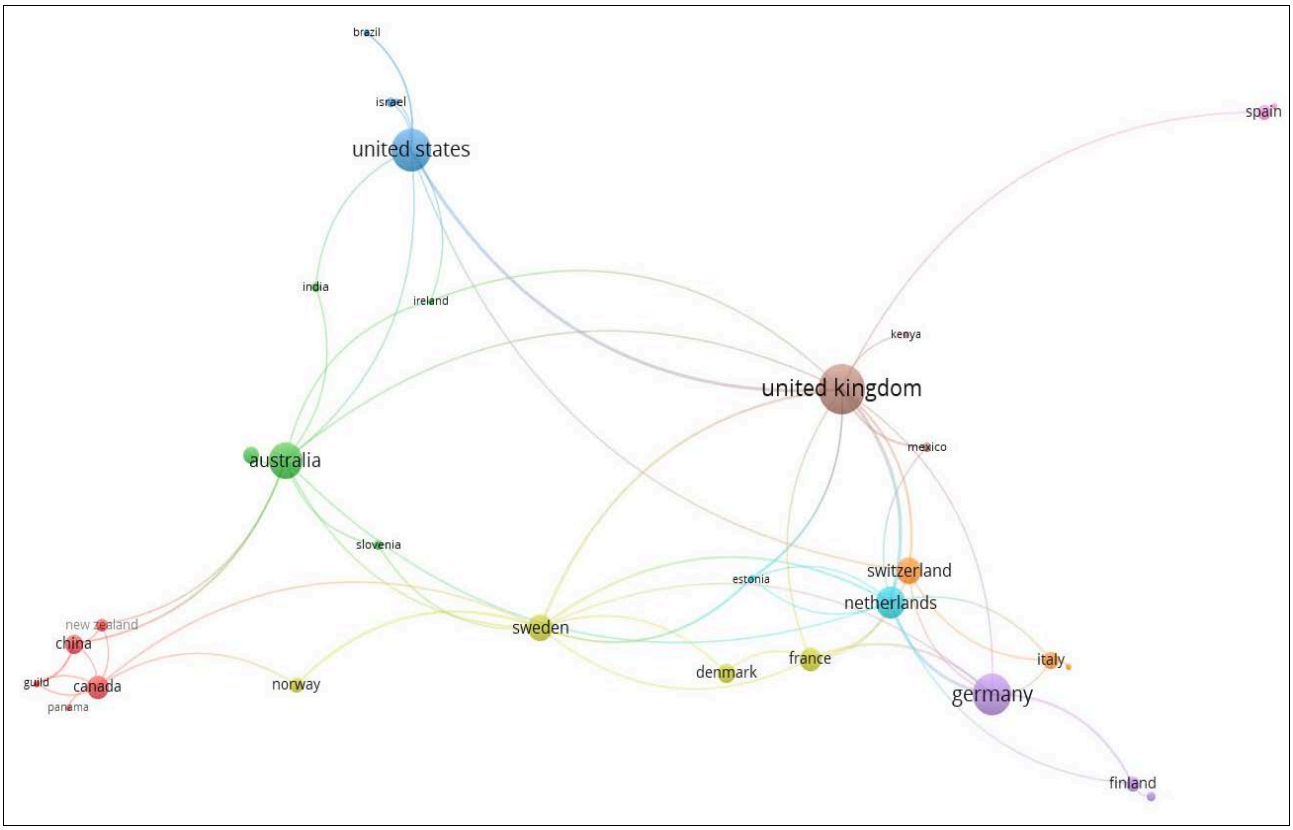


**Fig 3:** Countries with the highest citations are compiled using Vosviewer software.

In the current voluntary carbon offsetting program, the research team wanted to identify the leading country in this field. Therefore, the authors decided to conduct an analysis of countries. According to the data, a total of 45 countries have participated in research on voluntary carbon offset policies. In terms of the number of research publications, the United Kingdom currently leads with 28 publications and 775 citations. It is evident that the United Kingdom is the most influential and impactful country regarding this issue globally. Following in order are the United States (21 publications), Germany (20 publications), Australia (16 publications), and the Netherlands (13 publications).

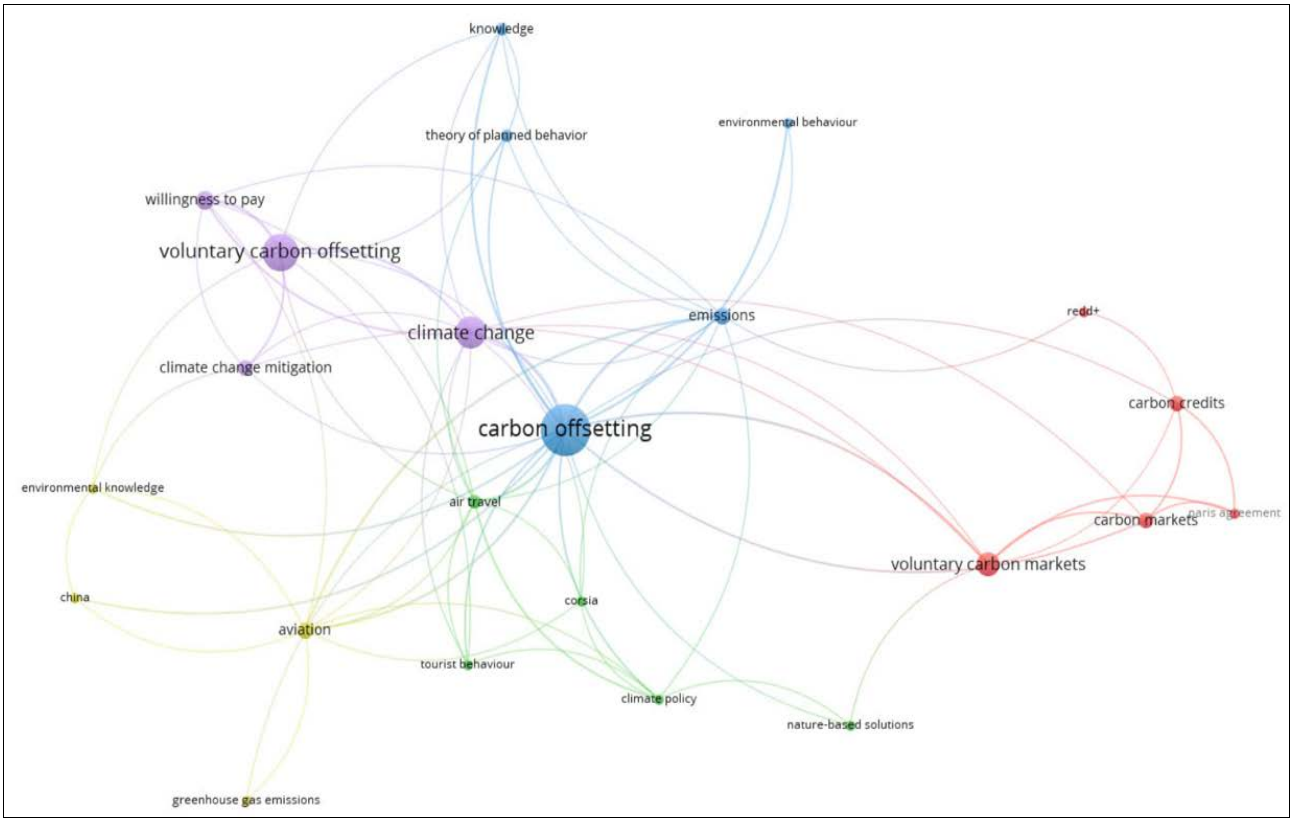


**Fig 4:** Keyword phrases of the analysis appear together

Figure 4 shows the results of keyword analysis, which led to the formation of five keyword clusters. Based on these clusters, the research team proposed several topics as follows:

Cluster 1 (Blue) focuses on carbon offsetting, the relationship between knowledge and environmental behavior in the Theory of Planned Behavior, and emissions (Denton *et al.*, 2020; Gössling *et al.*, 2007; Kim *et al.*, 2016) [6, 9]. Based on Cluster 1, the authors propose the topic "The Impact of Knowledge on Consumer Environmental Behavior." Table 2 shows that knowledge and environmental behavior, in the context of the Theory of Planned Behavior, play an important role in the intention to purchase voluntary carbon offsets.

Cluster 2 (Purple) concentrates on climate change and the role of willingness to pay for voluntary carbon offsets in mitigating climate change (Berger *et al.*, 2022; Choi & Ritchie, 2014; Rotaris *et al.*, 2020; Tao *et al.*, 2021) [2, 5, 19, 22]. This cluster proposes the topic "The Impact of Willingness to Pay for Voluntary Carbon Offsets on Climate Change Mitigation." Table 2 will illustrate the relationship between willingness to pay and the intention to purchase voluntary carbon offsets.

Cluster 3 (Red) primarily studies voluntary and non-voluntary carbon markets, the impact of carbon credits on climate protection, the REDD+ mechanism, and tracking the development of carbon markets through the 2015 Paris Agreement (Kreibich & Hermwille, 2021; Laing *et al.*, 2016; Sipthorpe *et al.*, 2022) [13, 14, 21]. This cluster represents research on "The Role of Voluntary Carbon Offsetting in the Carbon Market."

Cluster 4 (Green) focuses on the impact of air travel and tourism behavior on carbon neutrality, and the reverse effects of current carbon offset mechanisms, including the impact of the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) program, and climate policy impacts (Babakhani *et al.*, 2017; Scheelhaase & Maertens, 2020; Tyers, 2018) [1, 20, 23]. Therefore, the research direction of this cluster could be within the topic "Factors Influencing Carbon Credit Usage Behavior Based on the Impact of the CORSIA Program."

Cluster 5 (Yellow) highlights environmental knowledge concerning greenhouse gas emissions from the aviation sector in China (Lu & Wang, 2018; Park *et al.*, 2024) [15, 18]. Based on this, the authors propose the topic "The Role of Environmental Knowledge in the Aviation Sector in China." Table 2 will explain the impact of environmental knowledge on the intention to purchase voluntary carbon offsets.

**Table 2:** Summary of studies on the overview of intention to purchase voluntary carbon offset contributions by cluster

| Cluster | Author(s) | Factors Affecting Intention to Purchase Carbon Offset | Title | Journal |
|---|---|---|---|---|
| 1 | Gregory Denton & *et al.*, 2020 [6] | - Knowledge<br>- Beliefs<br>- Attitudes, trustworthiness<br>- Subjective norms<br>- Perceived behavioral control | An examination of the gap between carbon offsetting attitudes and behaviors: Role of knowledge, credibility, and trust | International Journal of Hospitality Management |
| | Stefan Gössling *et al.*, 2009 [10] | - Knowledge and Attitudes | Document details - Voluntary carbon offsetting schemes for aviation: Efficiency, credibility, and sustainable tourism | Journal of Sustainable Tourism |
| | Kim Yohan & *et al.*, 2016 | - Knowledge | How consumer knowledge shapes green consumption: An empirical study on voluntary carbon offsetting | International Journal of Advertising |
| 2 | Andy Choi & *et al.*, 2014 [5] | Attitudes, awareness, perception, and beliefs | Willingness to pay for flying carbon neutral in Australia: An exploratory study of offsetter profiles | Journal of Sustainable Tourism |
| | Judith Mair, 2011 [16] | Knowledge, attitudes, and awareness | Willingness-to-pay for carbon dioxide offsets: Field evidence on revealed preferences in the aviation industry | Global Environmental Change |
| | Yujie Tao & *et al.*, 2021 [22] | Knowledge, attitudes, personal norms, subjective norms, perceived behavioral control | Using an extended theory of planned behavior to explain willingness towards voluntary carbon offsetting among Chinese consumers | Ecological Economics |
| | Lucia Rotaris & *et al.*, 2020 [19] | Awareness | Are air travellers willing to pay for reducing or offsetting carbon emissions? Evidence from Italy | Transportation Research Part A: Policy and Practice |
| 3 | Nicolas Kreibich & *et al.*, 2021 [13] | - Legal framework<br>- Carbon neutrality commitment<br>- Availability<br>- Trust level | Caught in between: credibility and feasibility of the voluntary carbon market post-2020 | Climate Policy |
| | Timothy Laing & *et al.*, 2016 [14] | - Motivation<br>- Price<br>- Policy and regulations<br>- Co-benefits<br>- Project scale<br>- Transparency<br>- Willingness to invest<br>- Pressure | Understanding the demand for REDD+ credits | Environmental Conservation |
| | Sipthorpe & *et al.*, 2022 [21] | - Funding sources<br>- Legality and regulations<br>- Complexity<br>- Transparency<br>- Development level | Blockchain solutions for carbon markets are nearing maturity | One Earth |
| 4 | Roger Tyers, 2018 [23] | - Scale<br>- Importance<br>- Awareness<br>- Trust level<br>- Effectiveness | Nudging the jetset to offset: voluntary carbon offsetting and the limits to nudging | Journal of Sustainable Tourism |
| | Nazila Babakhani & *et al.*, 2017 [1] | - Effectiveness<br>- Transparency<br>- Choice<br>- Standards | Improving carbon offsetting appeals in online airplane ticket purchasing: testing new messages, and using new test methods | Journal of Sustainable Tourism |
| | Janina Scheelhaase & Sven Maertens, 2020 [20] | - Growth rate<br>- Voluntary participation<br>- Carbon offset policy<br>- Effectiveness | How to improve the global "Carbon Offsetting and Reduction Scheme for International Aviation" (CORSIA)? | Transportation Research Procedia |
| 5 | Jinlong Lu & *et al.*, 2018 [15] | Attitudes, knowledge | Investigating the impacts of air travellers' environmental knowledge on attitudes toward carbon offsetting and willingness to mitigate the environmental impacts of aviation | Transportation Research Part D: Transport and Environment |
| | Park Jihyeon & *et al.*, 2024 [18] | Environmental knowledge, attitudes, personal norms, subjective norms, perceived behavioral control | Factors influencing air passengers' intention to purchase voluntary carbon offsetting programs: The moderating role of environmental knowledge | Journal of Air Transport Management |

After analyzing 157 publications, it has been shown that the key factors have been identified and will have a strong impact between the clusters, while also linking them theoretically. From Table 2, it is evident that research on environmental knowledge, attitudes, and customer beliefs is the emerging trend for future studies on the intention to purchase carbon offset contributions from customers.

## Conclusions

This study aims to examine the current status and trends in scientific results regarding the intention to purchase voluntary carbon offset contributions. The research is based on the analysis of 152 publications retrieved from Scopus (from 2007 to 2024) and uses bibliometric analysis methods with the VOSviewer software tool. The results show that research on the topic of voluntary carbon offset contributions began to attract significant attention in 2014 and has primarily focused on factors influencing purchase intention, such as environmental awareness, personal attitudes, and social norms. Additionally, the study highlights that developed countries (the Netherlands, the US, the UK, Germany, Australia) contribute the most to the number of scientific publications on the overview of the intention to purchase voluntary carbon offset contributions. The literature review also emphasizes the importance of factors such as community awareness, the impact of incentive policies, and the effectiveness of communication in promoting the intention to purchase voluntary carbon offsets.

The research results have identified several trends and potential topics in the field of intention to purchase voluntary carbon offset contributions, providing important directions for future scholars:

Research on the relationship between environmental awareness and purchase intention, focusing on assessing how environmental awareness changes across different countries, regions, or specific groups. This is an emerging trend that many scholars are interested in.

The effectiveness of environmental communication campaigns, with communication being considered key in changing attitudes and purchase intentions. Future studies should focus on evaluating the effectiveness of advertising, social media, and educational campaigns in raising awareness and encouraging consumer action.

Research on the impact of supportive policies such as tax reductions and financial support, which are expected to drive participation from individuals and businesses. Future research is likely to focus on analyzing the effectiveness of these policies in various countries to propose suitable models.

The influence of social motivation and community norms, with social factors like peer pressure and community norms playing a crucial role in shaping purchase behavior. Further research on this relationship will help design more effective community strategies.

The trend of analyzing specific target groups, where studying purchase behavior based on demographic characteristics such as age, gender, occupation, or geographic region will help identify particular influencing factors, thus optimizing outreach campaigns.

Moreover, the study identifies prominent authors, leading countries, and relevant fields, providing a foundation for future research. These findings contribute to the development of theory and open practical opportunities to promote the intention to purchase voluntary carbon offset contributions, contributing to the global sustainable development goals.

Through bibliometric analysis, this study is useful in describing a comprehensive framework of foundational research and allows future scholars to focus on their own research more effectively. However, this study has limitations: (1) The sample in the study was recorded only in the Scopus database, and although Scopus covers a wide range of research topics, it does not fully encompass the topic of the overview of the intention to purchase voluntary carbon offset contributions; (2) During data collection, although the authors conducted a synthesis and selection based on Scopus sources, due to the relatively new nature of the topic on the overview of the intention to purchase voluntary carbon offset contributions, the number of articles is still limited.

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