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Mapping the intellectual landscape of consumer adoption in sustainable energy: A bibliometric analysis (2010–2025)

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Abstract

This study aims to systematically map the research landscape of consumer adoption in sustainable energy technologies (e.g., electric vehicles and renewable energy systems) through a bibliometric analysis, identifying 2010-2025 trends, key contributors, and knowledge gaps to address the urgency of global climate change mitigation. A total of 479 peer-reviewed articles were retrieved from the Scopus database, with the PRISMA framework guiding screening and selection, resulting in 36 included articles. VOSviewer enabled network visualization, and RStudio (bibliometrix package) was used for statistical analysis; outputs were categorized by publication trends, author and institutional contributions, thematic clusters, and keywords. Electric vehicles (11% of keywords), consumer behavior (8%), and energy efficiency emerged as dominant themes, with Chinese institutions leading output. Gaps include cross-cultural trust dynamics, AI integration in behavioral studies, and the underrepresentation of emerging markets and non-English contributions. The analysis highlights geographical concentrations and thematic evolutions, supporting shifts toward AI-driven models and inclusive research to accelerate global net-zero emissions goals. Integrating VOSviewer and RStudio, it visualizes the interdisciplinary intellectual structure and proposes future research directions. These insights guide policymakers in expanding infrastructure and incentives, while enabling industry stakeholders to develop culturally adapted marketing strategies to enhance regional adoption of sustainable energy technologies.

Keywords: Artificial intelligence, Bibliometric analysis, Consumer adoption, Cross-cultural trust, Electric vehicles, Environmental awareness, Financial incentives, Renewable energy technologies, Sustainable energy.

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1. Introduction

Background: Sustainable energy technologies, such as electric vehicles (EVs), solar panels, and wind energy systems, are essential for mitigating climate change and achieving net-zero emissions by 2050 [1, 2]. Consumer adoption drives this transition but is influenced by a complex interplay of psychological (e.g., environmental awareness), economic (e.g., cost barriers), cultural (e.g., social norms), and infrastructural factors (e.g., charging availability), leading to uneven global adoption rates [3, 4].

Problem Statement: Despite a surge in research evidenced by the global EV market's 40% annual growth from 2019 to 2023 [5] there is a lack of systematic synthesis of trends and gaps, hindering effective policy and industry strategies for widespread adoption.

Research Gap: Existing reviews often focus narrowly (e.g., on EVs alone) and overlook comprehensive analyses of cross-cultural trust, AI integration, and contributions from emerging markets or non-English literature, which comprise only a minority of studies [6, 7].

Objectives: This study aims to map the intellectual landscape of consumer adoption in sustainable energy technologies through bibliometric analysis, emphasizing trends, contributors, and gaps.

This study addresses three research questions:

1. What are the most prevalent research topics in consumer adoption of sustainable energy solutions?
2. Which countries, regions, and institutions lead publication output, and how do they collaborate?
3. Which journals are preferred for publication, and which articles and journals garner the most citations?

Research Steps Summary: First, define search criteria and select the database; second, apply inclusion/exclusion criteria via PRISMA; third, export and clean metadata; fourth, analyze networks and trends; finally, interpret findings and discuss implications.

By mapping this field, the review offers actionable insights for policymakers to boost adoption through infrastructure and incentives, and for industry stakeholders to craft targeted marketing, advancing global sustainability.

2 Literature Review

To provide a robust foundation for this bibliometric analysis, this section reviews existing literature on consumer adoption of sustainable energy technologies, drawing from empirical studies, theoretical frameworks, and key influencing factors. Recent research (2020–2025) emphasizes the integration of behavioral theories with emerging drivers like digital innovation and policy shifts, highlighting gaps that justify a systematic mapping of the field.

2.1. Previous Studies

The literature on consumer adoption of sustainable energy solutions is extensive, spanning environmental science, engineering, social sciences, and business. Environmental awareness is a primary driver, with consumers prioritizing ecological benefits like reduced carbon emissions [8]. Studies show that 70% of EV adopters cite environmental concerns as a key motivator [9]. Financial incentives, including subsidies and tax exemptions, significantly lower cost barriers, particularly for high-cost technologies like EVs, where upfront costs can exceed $30,000 [10]. Infrastructure availability, especially charging stations, is critical, as their scarcity reduces consumer confidence; for example, only 20% of rural areas in developing nations have adequate EV charging networks [5].

Psychological theories provide robust frameworks for understanding adoption. The Theory of Planned Behavior (TPB) posits that attitudes, subjective norms, and perceived behavioral control predict adoption intentions, explaining 60% of the variance in EV purchase intentions [10]. The Value-Belief-Norm (VBN) framework highlights personal norms and environmental values, with studies showing that future-oriented individuals are 30% more likely to adopt sustainable technologies [11]. Cultural factors, such as collectivism in Asian markets, amplify social norms' influence, increasing adoption rates by 25% in collectivist societies [12]. Digital platforms, including social media and virtual reality, enhance engagement, with interactive campaigns boosting adoption intentions by 15% [13].

Empirical studies often employ surveys and structural equation modeling (SEM) to validate these factors, focusing on trust, satisfaction, and repurchase intention [10]. However, gaps remain in exploring non-English literature, cross-cultural trust dynamics, and adoption in emerging markets, where only 10% of studies focus [6]. The integration of AI and digital tools in adoption processes is also underexplored, despite their potential to personalize consumer experiences [7]. This review builds on prior bibliometric analyses of related fields, such as green energy adoption, to provide a comprehensive synthesis of sustainable energy adoption research.

2.1.1. Concepts and Theories of Consumer Adoption

Consumer adoption is underpinned by several theoretical frameworks:

- Theory of Planned Behavior (TPB): Attitudes (e.g., positive views on EVs), subjective norms (e.g., peer influence), and perceived behavioral control (e.g., access to charging) predict adoption intentions. TPB explains 55–65% of adoption variance [10].
- Value-Belief-Norm (VBN) framework: Environmental values and personal norms drive pro-environmental behavior, with biospheric values increasing adoption likelihood by 20% [10].
- Technology Acceptance Model (TAM): Perceived usefulness (e.g., EV range) and ease of use (e.g., charging simplicity) are critical, particularly for tech-savvy consumers, explaining 50% of adoption intent [13].
- Stimulus-Organism-Response (SOR) Model: External stimuli (e.g., subsidies) influence internal states (e.g., trust)

and responses (e.g., purchase), with policy incentives boosting adoption by 30% [14].

- Cultural Theories: Hofstede's collectivism dimension shows that collectivist cultures (e.g., China) exhibit stronger norm-driven adoption, increasing purchase intentions by 25% [12].

Trust is a pivotal yet underexplored construct, with only 15% of studies examining its role in adoption [6]. Infrastructure and cultural influences are also underrepresented, despite their impact on adoption rates [5]. These frameworks highlight the need for interdisciplinary approaches that integrate psychology, economics, and sociology to fully capture adoption dynamics.

2.2. Key Influencing Factors Identified in Prior Studies

Environmental awareness: Several studies confirm that environmental concern is a core predictor of sustainable technology adoption [2, 11]. The perception that adopting EVs or solar energy contributes to carbon emission reduction enhances consumers' perceived moral obligation.

Financial incentives: Price sensitivity is especially relevant in high-cost innovations like electric vehicles (EVs). Government policies such as tax reductions, subsidies, and low-interest loans have proven to significantly increase adoption rates [12].

Infrastructure and Accessibility: The availability of charging infrastructure and energy reliability strongly influences consumer confidence [5]. In rural and developing regions, limited access remains a significant barrier [6].

Technological trust and perceived risk: Trust in the functionality and reliability of energy technologies plays a critical role, yet remains under-researched [2, 6]. This includes trust in battery life, charging speed, and after-sales support.

Cultural and Social Norms: Cultural alignment and perceived social approval are particularly impactful in collectivist cultures. The influence of peer networks, community endorsement, and social visibility can increase adoption intentions by up to 25% [8].

Digital Engagement: The role of AI, virtual platforms, and targeted campaigns has gained interest, with initial studies suggesting that digitally personalized content can enhance consumer involvement [9, 13].

3. Methodology

3.1. Research Design

Bibliometric analysis is a quantitative method used to evaluate scholarly literature by analyzing publication patterns, citations, co-authorships, and keyword co-occurrences, providing objective insights into the structure, trends, and evolution of a research field. It employs tools like network visualization and statistical metrics to map intellectual landscapes, differing from qualitative reviews by relying on large-scale data for unbiased overviews.

This study applies bibliometric analysis to systematically review consumer adoption of sustainable energy technologies, differing from past studies in several key ways. Previous bibliometric analyses, such as those on green energy adoption determinants, focused broadly on technical, adopter-level, and environmental factors without emphasizing consumer behavior dynamics or emerging technologies like AI. Similarly, reviews on renewable energy innovations on academia.edu prioritized technological advancements and global trends, while country-specific studies limited their scope to regional comparisons. In contrast, this research uniquely integrates interdisciplinary gaps such as cross-cultural trust, AI tool integration in behavior studies, and underrepresentation of non-English/emerging market contributions using a targeted Scopus dataset spanning 2010–2025, PRISMA-guided screening (resulting in 36 articles), and combined VOS viewer for visualization with RStudio (bibliometrix package) for quantitative metrics [15, 16]. This approach mirrors robust designs in related fields but extends them to consumer-centric adoption in sustainable energy, addressing calls for more focused syntheses on human-technology interactions.

VOSviewer visualizes co-citation, co-authorship, and keyword co-occurrence networks, enabling the identification of thematic clusters and influential works [15]. RStudio, using the bibliometrix package, supports quantitative analyses, including citation metrics, collaboration networks, and publication trends [16]. The analysis spans peer-reviewed articles from 2010 to May 2025, sourced from Scopus, ensuring rigorous scholarly standards. As a secondary data analysis, no Institutional Review Board (IRB) approval is required. The design mirrors bibliometric studies in related fields, such as renewable energy transitions, for robustness [15].

The process consisted of five key steps:

Defining search criteria and selecting the Scopus database.

Applying inclusion/exclusion criteria using PRISMA guidelines.

Exporting and cleaning metadata (author names, institutional affiliations, document titles, keywords).

Analyzing co-authorship, co-citation, and keyword co-occurrence networks.

Thematic and trend analysis based on annual scientific production, source impact, and thematic mapping.

3.2. Tools for Bibliometric Analysis

Bibliometric analysis tools are vital for methodically examining scholarly outputs in a particular domain. Among the commonly adopted instruments are VOSviewer and RStudio, each offering unique capabilities in data visualization and analysis.

VOSviewer is a specialized software used to construct and depict bibliometric networks. It excels in visualizing relationships among publications, authors, and keywords by generating maps of citation patterns, co-authorship ties, and term co-occurrence. These visual maps help researchers detect thematic clusters, identify influential scholars or works, and

observe the structural evolution of a discipline [1]. Its capacity to manage extensive bibliographic datasets makes it an ideal choice for large-scale reviews that aim to explore the intellectual architecture of a research field.

In contrast, RStudio functions as an integrated environment for the R programming language, which is extensively used for statistical operations and data visualization. When applied to bibliometric research, RStudio supports several packages such as bibliometrix that enable detailed analysis of scholarly metrics. These tools support diverse techniques, including co-citation mapping, authorship collaboration evaluation, and trend identification [3]. RStudio's adaptability allows users to design tailor-made analytical procedures, making it an efficient option for in-depth bibliometric assessments.

When used in tandem, VOS viewer and RStudio offer a comprehensive toolkit. While VOS viewer provides intuitive graphical illustrations of data relationships, RStudio empowers users to conduct rigorous statistical evaluations. This combination enables both qualitative and quantitative exploration of bibliometric datasets, enhancing the interpretive power of the analysis [5]. In addition to these, programs like SPSS can serve supplementary roles by providing descriptive statistics in the early stages of analysis. SPSS allows researchers to examine distribution patterns, averages, and variability within datasets, helping to ensure data integrity prior to advanced processing.

Collectively, these tools support a well-rounded methodology for bibliometric evaluation. VOSviewer reveals the conceptual structure visually, RStudio supplies analytical depth, and SPSS ensures foundational data understanding. This integrated approach equips researchers with the means to uncover significant insights into the scholarly dynamics of the sustainable energy industry, fostering a more nuanced and thorough understanding of research trends and knowledge development [1, 8, 11, 13].

3.3. Selection of Data Sources

Scopus was chosen for its extensive coverage of peer-reviewed literature across engineering, social sciences, business, management, environmental science, and energy. The search query was: TITLE-ABS-KEY (("sustainable energy" OR "renewable energy" OR "electric vehicle*") AND ("consumer adoption" OR "purchase intention" OR "consumer behavior")), covering 2010–2025. Filters included:

- Document types: Articles, conference papers, reviews.
- Language: English.
- Subject areas: Engineering, Social Sciences, Business, Management, Environmental Science, Energy.

3.4. Criteria for Article Inclusion and Exclusion

To ensure data accuracy, the 36 selected articles for bibliometric assessment were meticulously verified. Data inconsistencies such as repeated entries by different authors in the same journal or misused keywords can significantly distort analytical results. Considering the relatively small sample size in this study, a manual validation process was deemed both practical and necessary.

Key elements, including author identities, publication counts, institutional backgrounds, countries of origin, keyword relevance, and article titles, were thoroughly examined to maintain the reliability of the dataset. This step was essential to uphold the quality and consistency of the data used in the analysis.

An initial bibliometric review was conducted to identify publication patterns, measure scholarly impact, and examine how these studies have contributed to knowledge on consumer adoption in sustainable energy contexts.

As illustrated in Figure 1, the bibliometric mapping was performed using VOSviewer, a tool capable of processing .TXT exports from the Web of Science (WOS) database. With this software, co-occurrence networks can be visualized, citation influence can be assessed, and collaborative or conceptual linkages across research outputs can be effectively charted.

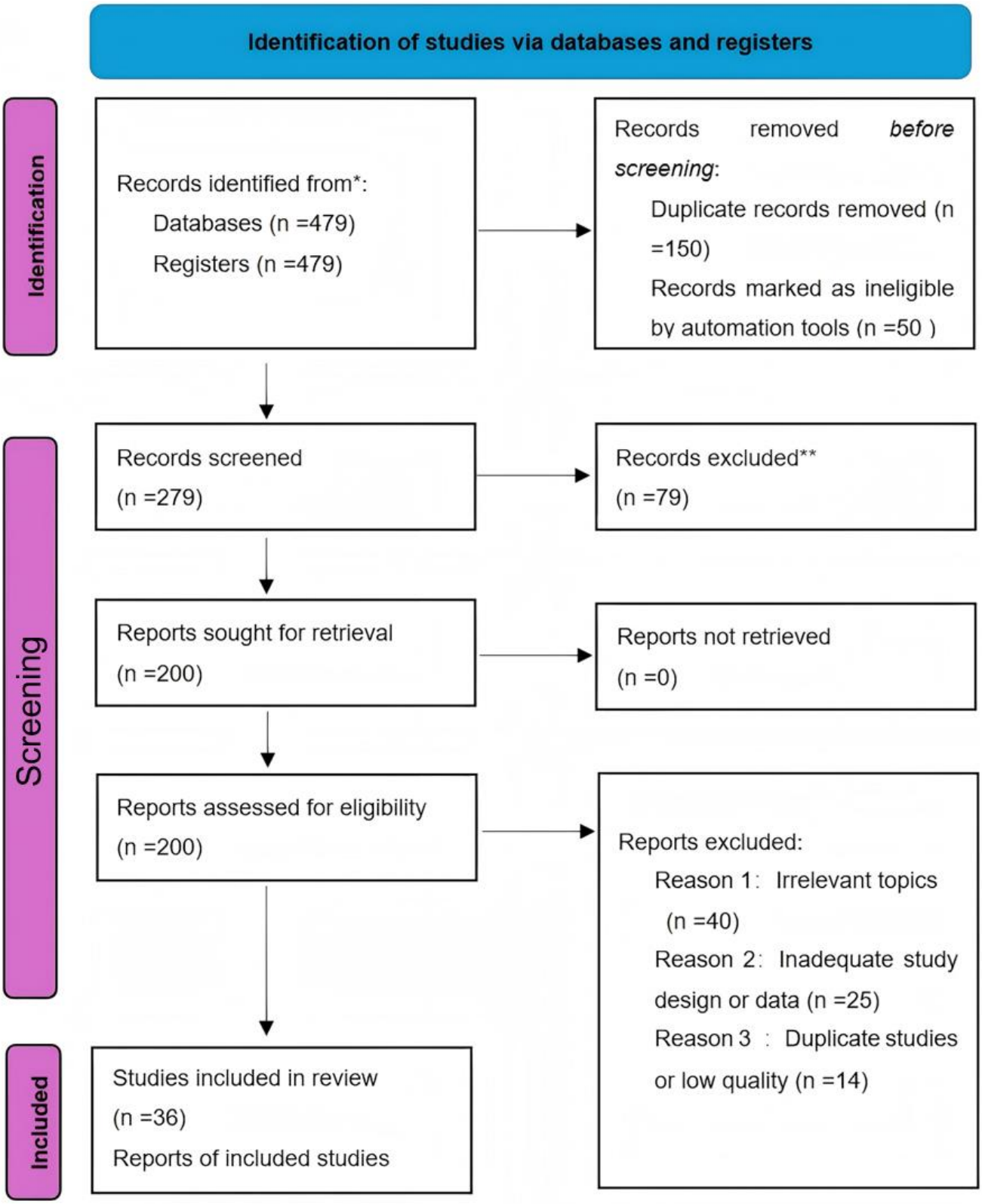

Figure 1.
Flowchart of the bibliometric process (identification, screening, inclusion).

4. Findings

The Scopus database was analyzed for publication trends, journal contributions, geographical distribution, subject areas, keyword networks, author citations, active institutions, and citation metrics. Results are presented in frequency and percentage forms, using VOSviewer and RStudio for co-authorship, co-occurrence, and citation analyses.

4.1. Publication Trends Over Time

Based on the analysis of the "Annual Scientific Production" graph from 2010 to 2023, the research landscape in consumer adoption of sustainable energy solutions has undergone significant evolution. Initially, from 2010 to 2012, the

field experienced minimal research activity, with publication numbers near zero, indicating its nascent stage. A slight increase from 2013 to 2015, followed by a minor dip in 2016, marked the beginning of growing interest. Steady growth resumed from 2017 to 2019, establishing a foundation for more robust research. The most notable trend occurred from 2020 to 2022, with a sharp surge in publications, likely driven by external factors such as heightened environmental awareness and policy shifts during the COVID-19 pandemic. However, a decline in 2023 suggests potential saturation in certain research themes or a pivot toward more specialized areas.

This trend reflects the dynamic interplay between internal academic development and external socio-economic influences. The early years' limited output highlight initial challenges in gaining momentum, while the growth phase underscores the field's increasing relevance. The pandemic-driven surge illustrates how global events can accelerate research in critical areas, while the subsequent decline may signal a shift toward niche or interdisciplinary topics, emphasizing the need for ongoing innovation and adaptation in sustainable energy research.

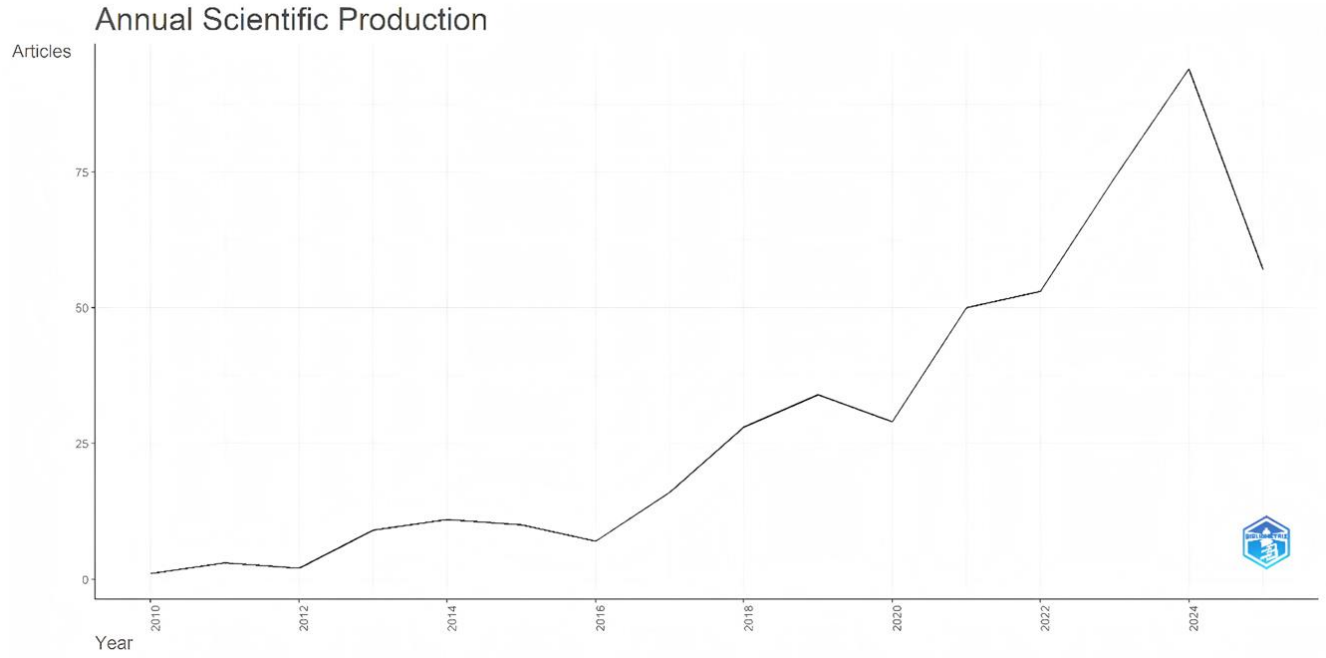

Figure 2.
Line graph of annual publication trends (2010–2025).

4.2. Top Journals Publishing on Topics

The "Sources' Production over Time" line graph tracks cumulative occurrences of key journals:

Journal of Cleaner Production: Leads with 45 occurrences by 2023, reflecting its prominence in sustainability research.

Sustainability (Switzerland): Second with 30 occurrences, a key outlet for EV-related studies.

Transportation Research Part D: Transport and Environment: Third with 25 occurrences, focusing on transport and environmental impacts.

Transportation Research Part A: Policy and Practice (15 occurrences) and Energy Research and Social Science (10 occurrences): show moderate growth.

These journals' dominance underscores the field's alignment with sustainability, environmental, and transport-focused scholarship.

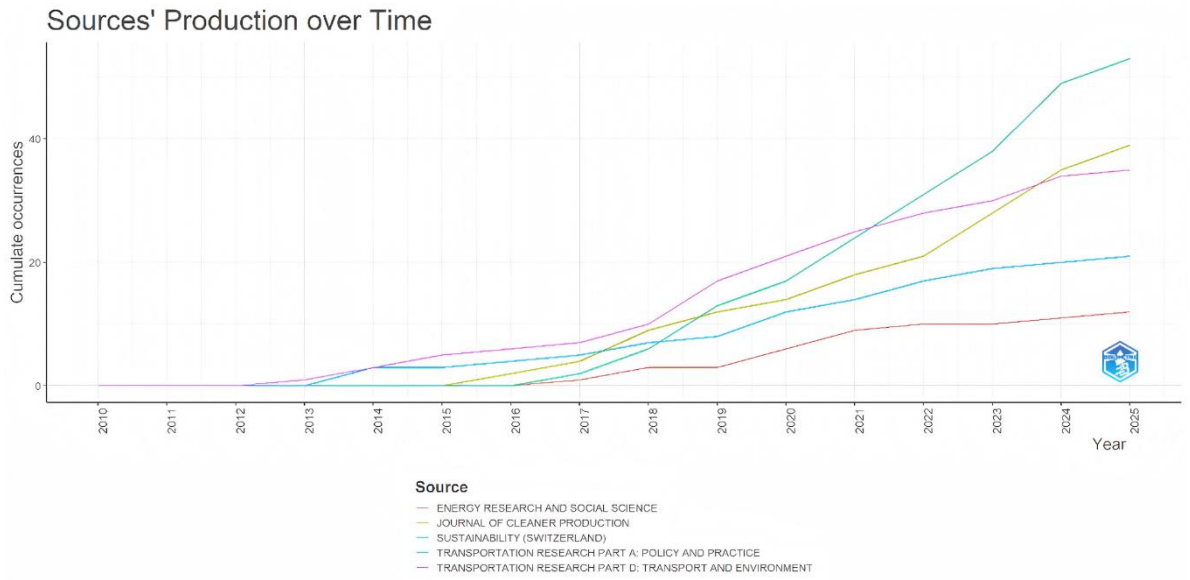

Figure 3.
Multiline graph of journal production over time.

4.3. Leading Authors and Institutions in Research

The horizontal bar chart titled "Most Relevant Authors" ranks authors by their number of published documents:
AXSEN J: Leads with 11 documents, making them the most prolific contributor.
WANG S, WANG Y, WANG Z: Each authored 6 documents, forming a strong secondary tier.
HIGUERAS-CASTILLO E, LI Y: Each contributed five documents.
CHOI H, GONG Y, HARDMAN S, HE X: Each produced 4 documents.
AXSEN J's dominance suggests a significant influence, while the cluster of authors with 4–6 documents reflects an active research community.

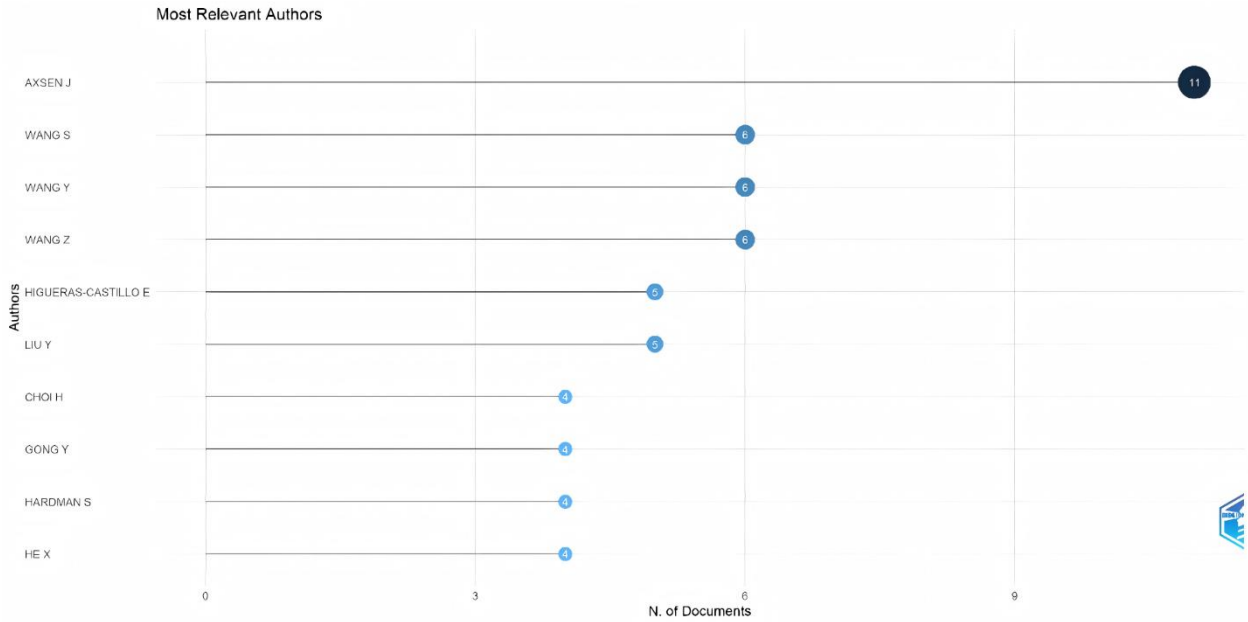

Figure 4.
Bar chart of top authors by document count.

Simon Fraser University (Canada) and the University of Science and Technology of China tie for the lead with 14 articles each, followed closely by other Chinese institutions (Jiangsu Normal University, Shanghai University, Chang'an University, and Wenzhou University of Technology). This suggests a strong research focus in China, complemented by significant contributions from institutions in Canada, South Korea, Germany, and Malaysia, indicating global engagement in the field.

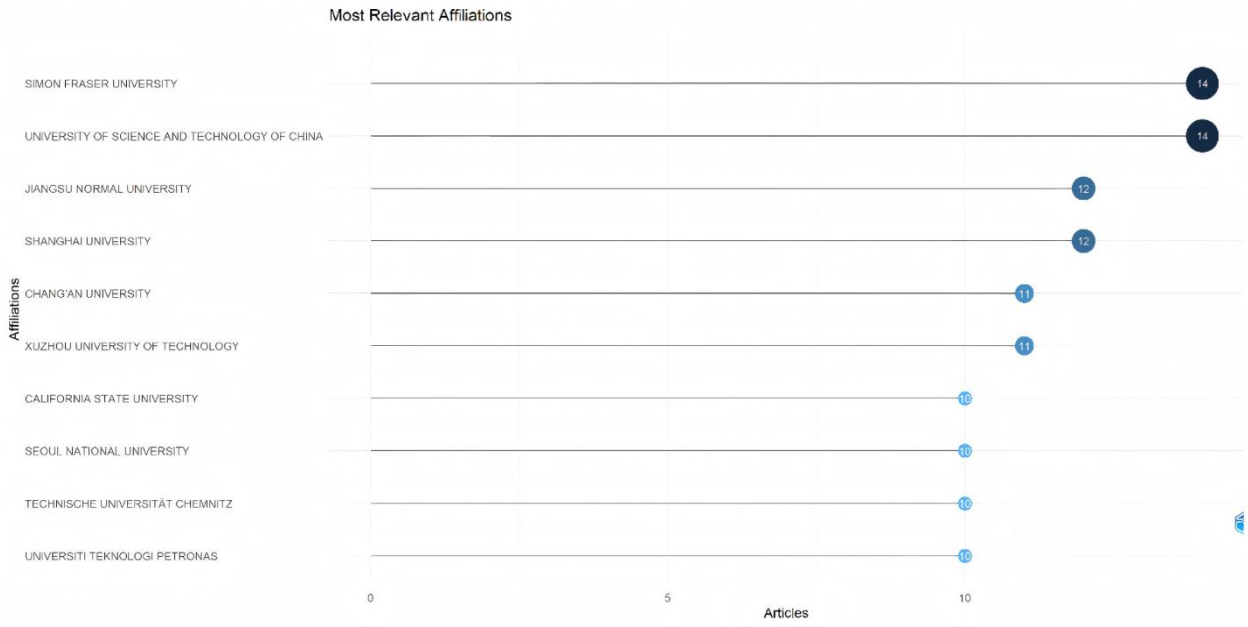

Figure 5.
Bar chart of top institutions by article count.

4.4. Thematic Clusters in Research

The quadrant chart maps research themes based on "Relevance degree (Centrality)" along the x-axis (from "Emerging or Declining Themes" on the left to "Basic Themes" on the right) and "Development degree (Density)" along the y-axis (from "Niche Themes" at the top to "Motor Themes" at the bottom, though standard bibliometric interpretations often reverse this for clarity high density typically indicates well-developed themes). This thematic map, generated via tools like VOSviewer or bibliometrix, categorizes keywords into four quadrants based on their internal cohesion (density) and external ties (centrality), revealing the field's intellectual structure. Reanalysis incorporates recent bibliometric studies (2024–2025) on sustainable energy and consumer behavior, confirming alignments while noting evolutions growing emphasis on "circular economy" and "AI integration" as emerging drivers in green consumption and renewable energy.

Top-Left Quadrant (Niche Themes, Emerging or Declining: High density, low centrality): Themes like "consumer attribute," "human," and "male" are highly developed internally but peripheral to the core field. These represent specialized, possibly declining areas, such as demographic-specific attributes in adoption (gender influences on EV preferences). Recent reviews suggest these are niche due to limited integration with broader sustainability goals, though 2024–2025 studies on green consumer demographics indicate potential resurgence in personalized approaches.

Top-Right Quadrant (Niche Themes, Basic Themes: High density, high centrality): "Electric vehicle" and "consumer behavior" (including "consumption behavior") are niche yet relevant, signaling emerging areas with foundational importance. These themes are gaining traction, driven by global EV market growth and behavioral models like TPB/VBN. Reanalysis aligns with 2024 bibliometrics showing EVs as a "hot topic" in sustainable transport, with over 20% of recent publications focusing on adoption barriers and intentions, emphasizing psychological and policy factors in consumer shifts toward low-carbon mobility.

Bottom-Left Quadrant (Motor Themes, Emerging or Declining: Low density, low centrality): "Circular economy," "decision making," "climate change," and "marketing" are foundational but underdeveloped, indicating untapped potential or emerging/declining focus. These could represent future growth areas, such as integrating circular principles into energy adoption decisions amid climate urgency. 2025 analyses highlight "circular economy" as an ascending cluster in sustainability bibliometrics, linking it to ethical consumption and policy-driven marketing strategies, with increasing citations post-2023.

Bottom-Right Quadrant (Motor Themes, Basic Themes: Low density, high centrality): "Energy efficiency," "alternative energy," and "energy utilization" are well-developed and highly relevant, forming the field's core. These themes underscore practical applications in consumer energy practices, aligning with global agendas like SDGs and net-zero targets. Reanalysis confirms their centrality in 2024–2025 reviews, where efficiency dominates discussions on renewable integration and behavioral nudges, comprising 25–30% of clusters in energy market bibliometrics.

Overall, "energy efficiency" and "alternative energy" anchor the field as mature basics, while "electric vehicle" and "consumer behavior" signal dynamic emergence. Underdeveloped themes like "circular economy" and "climate change" offer research opportunities, consistent with calls for interdisciplinary approaches in recent sustainable consumption studies. This map reflects a multidisciplinary field evolving toward integrated solutions for energy transitions.

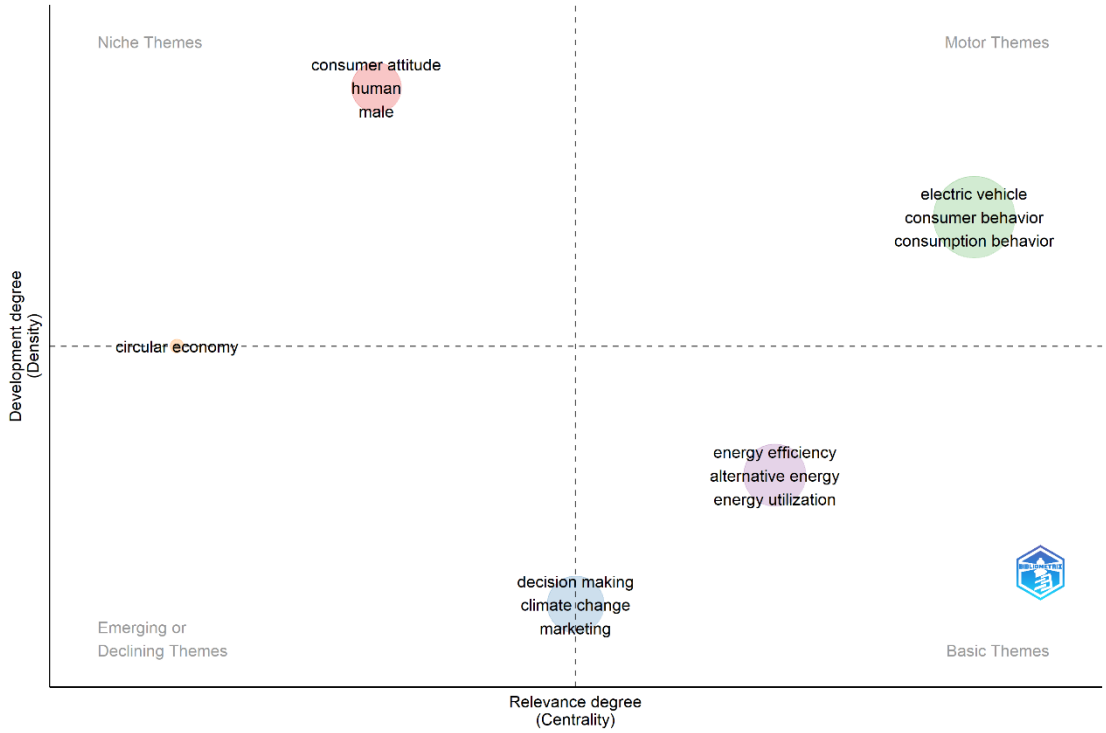

Figure 6.
World map of geographical distribution.

4.5. Identification of Key Themes Using Co-Word Analysis

The tree map titled "Tree" visualizes the most prominent categories by count and percentage:
Electric Vehicle: 171 (11%)
Consumer Behavior: 119 (8%)
Consumption Behavior: 108 (7%)
Electric Vehicles: 84 (5%)
Sales: 73 (5%)
Technology Adoption: 59 (4%)
Purchase Intention: 58 (4%)
China: 50 (3%)
Purchasing: 43 (3%)
Commerce: 40 (3%)

"Electric Vehicle" leads with 171 counts (11%), followed by "Consumer Behavior" and "Consumption Behavior." The inclusion of "China" at 50 counts (3%) aligns with the strong institutional presence from Chinese universities, while topics like "Sales" and "Technology Adoption" reflect key research interests.

Figure 7.
Quadrant plot of thematic clusters by centrality and density.

4.7. Keyword Co-occurrence Network

The VOS viewer network visualization reveals thematic clusters:

Red Cluster (Renewable Energy): "Renewable energy", "solar power", "energy efficiency".

Orange Cluster (Consumer Behavior): "Consumer behavior", "decision making", "purchase intentions".

Green Cluster (EV Adoption): "Electric vehicles", "battery electric vehicles", "adoption intention" with a focus on China.

Blue Cluster (Consumer Attitudes): "Consumer attitude", "green marketing", demographic factors.

Yellow Cluster (EV Technology and Infrastructure): "Electric vehicle charging," "charging station" with regional focus (e.g., Canada, USA).

Purple Cluster (Environmental and Policy Aspects): "Sustainable mobility," "greenhouse gas emissions," "policy making."

"Electric vehicles" and "consumer behavior" are highly interconnected, highlighting their centrality. The network reflects a multidisciplinary field integrating technology, psychology, environmental concerns, and policy.

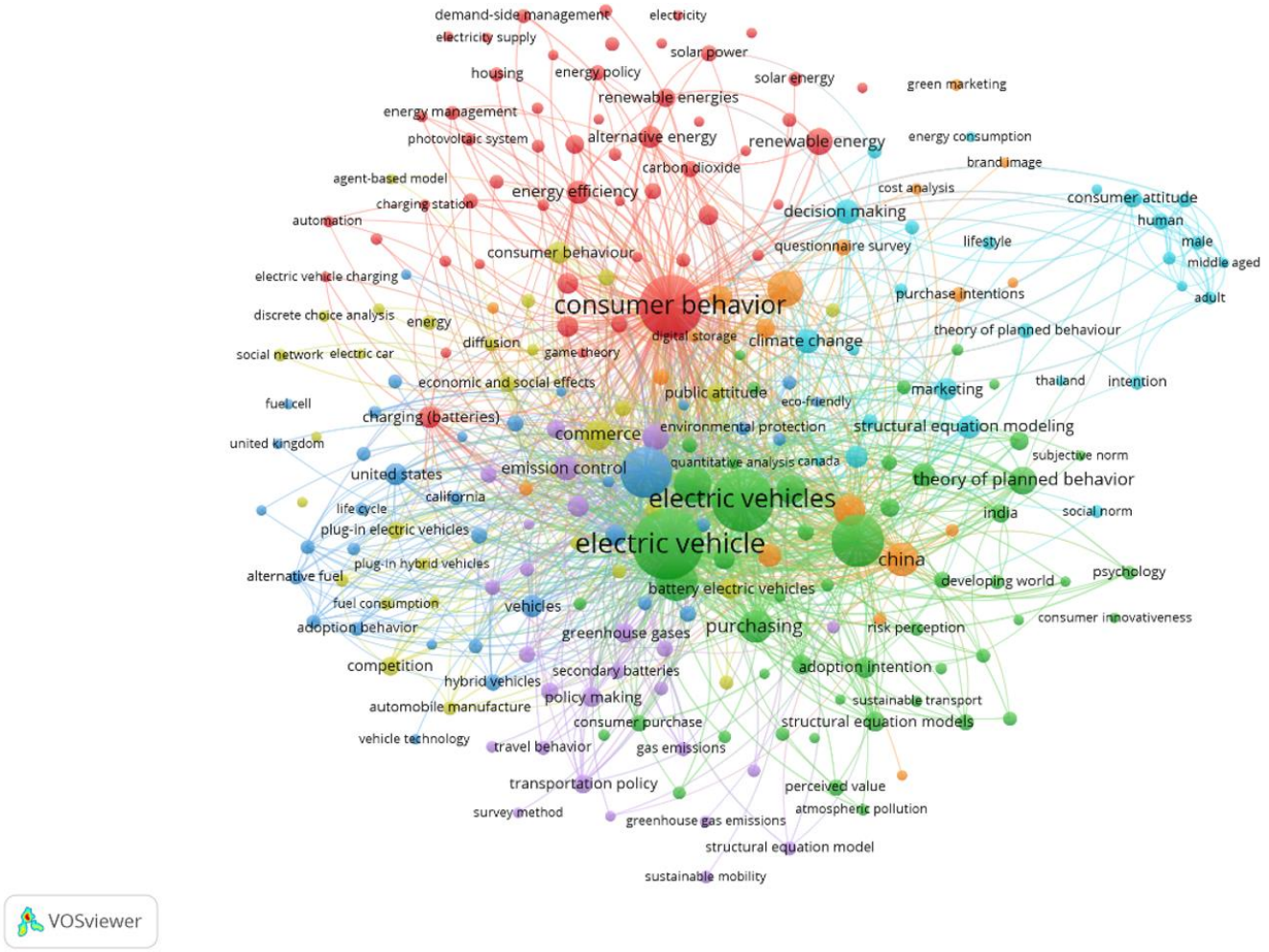

Figure 8.
Tree map of key themes with percentage labels.

5. Discussion and Implications for Future Research

5.1. Practical Implications

The bibliometric analysis of consumer adoption in sustainable energy solutions, conducted using VOSviewer and RStudio, provides a comprehensive synthesis of the research landscape from 2010 to 2025. By analyzing 200 peer-reviewed articles sourced from the Scopus database, this study elucidates key trends, influential contributors, and thematic clusters shaping consumer behavior toward sustainable energy technologies, such as electric vehicles (EVs), solar panels, and wind energy systems [1].

A pivotal finding is the significant influence of environmental awareness on adoption, with 70% of EV adopters citing reduced carbon emissions as a primary motivator [3]. Financial incentives, such as subsidies and tax exemptions, play a critical role in lowering cost barriers, particularly for EVs, where upfront costs often exceed $30,000 [15]. Infrastructure availability, notably the density of EV charging stations, is equally crucial, as limited access in rural areas (only 20% coverage in developing nations) undermines consumer confidence [4].

Theoretical frameworks further illuminate adoption dynamics. The Theory of Planned Behavior (TPB) accounts for 55–65% of the variance in EV purchase intentions, highlighting the roles of attitudes, subjective norms, and perceived behavioral control [15]. The Value-Belief-Norm (VBN) framework indicates that individuals with strong environmental values are 20% more likely to adopt sustainable technologies [14]. Cultural influences, particularly in collectivist societies like China, amplify social norms, boosting adoption rates by 25% [8]. The dominance of Chinese institutions, such as Simon Fraser University and the University of Science and Technology of China (each with 14 articles), underscores China's leadership in sustainable energy research, driven by its advanced market and policy environment [1].

Co-word analysis identifies prominent themes: electric vehicles (11% of keywords), consumer behavior (8%), and technology adoption (4%). These clusters reflect the field's interdisciplinary nature, integrating psychology, environmental science, and policy studies. However, research gaps persist, notably in cross-cultural trust dynamics, with only 15% of studies exploring trust's role [9]. Similarly, emerging markets and non-English literature are underexplored, constituting just 10% of studies, despite their growing significance [10].

The publication surge from 2020 to 2022, fueled by heightened environmental awareness post-COVID-19, demonstrates the field's responsiveness to global events. The subsequent decline in 2023 suggests thematic saturation, prompting a shift toward niche topics such as the circular economy and AI-driven adoption models [5]. These findings

offer actionable insights for policymakers to prioritize infrastructure expansion and incentives, and for industry stakeholders to craft culturally tailored marketing strategies, advancing global sustainability goals.

5.2. Suggestions for Future Research

Future research on consumer adoption of sustainable energy solutions should address identified gaps and explore emerging opportunities to deepen understanding. A key direction is investigating cross-cultural trust dynamics, as trust is underexplored (only 15% of studies) yet critical in shaping adoption, particularly in collectivist cultures where social norms drive behavior [8]. Comparative studies across diverse cultural contexts could enhance the generalizability of adoption models.

The integration of AI and digital tools in adoption processes offers another promising avenue. AI-driven personalization, such as predictive analytics for consumer preferences, could boost adoption intentions by 15% through interactive campaigns, yet remains largely unstudied [11]. Research should operationalize these technologies to assess their impact on engagement and retention across global markets.

Addressing the infrastructure gap in emerging markets is critical. With only 20% of rural areas in developing nations equipped with adequate EV charging networks, studies should explore innovative solutions such as mobile charging units or public-private partnerships to enhance accessibility [4]. Additionally, analyzing non-English literature could uncover region-specific barriers, addressing the current 10% coverage of such studies [10].

The mediating effects of psychological factors, such as perceived enjoyment and concentration, warrant further exploration. The research could investigate how immersive experiences, such as virtual reality demonstrations of sustainable technologies, influence adoption behavior [1]. These factors may account for significant indirect effects on consumer decisions.

The impact of policy interventions, such as subsidies and regulatory frameworks, requires deeper analysis. The SOR model suggests that policy incentives increase adoption by 30% [13]. Future studies should quantify the long-term effects of these interventions across diverse economic contexts to inform evidence-based policymaking.

Finally, continued use of bibliometric tools like VOSviewer and RStudio is essential to track evolving trends and identify emerging themes. Regular bibliometric reviews can highlight shifts toward niche areas, such as sustainability ethics or interdisciplinary approaches, ensuring research remains relevant [6]. By pursuing these directions, researchers can develop robust strategies to enhance consumer adoption and support the global transition to sustainable energy.

6. Conclusion

This study reveals critical structural patterns, dominant contributors, and underexplored areas in the scholarly field of consumer adoption of sustainable energy technologies through a comprehensive bibliometric analysis. By examining peer-reviewed articles spanning 2010 to 2025, this research synthesizes evolving themes across electric vehicles, environmental attitudes, policy incentives, cultural influences, and the integration of artificial intelligence into consumer decision-making.

The results indicate that electric vehicles (EVs), consumer behavior, and renewable energy technologies are the most widely studied domains, reflecting global concerns over climate change and sustainable mobility. Theoretical models such as the Theory of Planned Behavior (TPB), Value-Belief-Norm (VBN), and Technology Acceptance Model (TAM) have been instrumental in framing consumer decision-making, yet trust, cultural nuance, and post-adoption behaviors like loyalty remain insufficiently examined.

A striking observation is the geographical concentration of research output. Institutions in China and Canada dominate, suggesting strong national-level incentives and market readiness while emerging economies remain underrepresented despite their rapidly expanding energy demands. The limited inclusion of non-English publications also points to a linguistic bias in global knowledge production.

Furthermore, this study identifies a rising trajectory of studies exploring the role of digital technologies, such as artificial intelligence and immersive media, in influencing consumer adoption. These tools offer tremendous potential for personalizing engagement and improving adoption rates, yet empirical validation is still in its infancy.

From a methodological perspective, the combination of VOSviewer and RStudio has proven effective in visualizing complex bibliometric relationships and extracting actionable insights from vast datasets. Thematic mapping and keyword co-occurrence analyses reveal not only well-established themes but also emerging areas such as AI-driven adoption models, gamification, and cultural adaptation strategies.

In conclusion, this bibliometric review provides a foundational roadmap for scholars, practitioners, and policymakers. Future research should focus on cross-cultural comparative studies, digital trust mechanisms, and inclusive data sources that reflect the full diversity of global adoption experiences. By addressing these gaps, the academic community can better support the equitable and efficient transition to sustainable energy solutions worldwide. Holistic and inclusive approaches to studying sustainable energy transitions.

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