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# Artificial Intelligence in Green Marketing: A Systematic Literature Review

**Yutao Mei [1], Linling Geng [2], Xinwei Cao [1,*] and Yu Xie [2,*]**

[1] School of Business Management, Jiangnan University, Wuxi 214122, China
[2] College of Economics and Management, Nanjing Forestry University, Nanjing 210037, China
* Correspondence: xwcao@jiangnan.edu.cn (X.C.); xieyu@njfu.edu.cn (Y.X.)

**Abstract**

As environmental sustainability pressures intensify and AI technologies rapidly evolve, the integration of AI into green marketing strategies has become increasingly prominent. This systematic review examines the application of artificial intelligence (AI) in green marketing, with a focus on studies published between 2020 and 2024. This review addresses two key research questions: the effectiveness of different types of artificial intelligence in green marketing applications, and the role of AI in supporting enterprise development in this context. A comprehensive search of SpringerLink, Web of Science, and Google Scholar initially identified 200 records. After duplicate removal and multi-stage screening, 47 articles were deemed to meet the inclusion criteria. Only peer-reviewed journal articles in English were included. Study quality was appraised using established evaluation criteria to ensure methodological rigor. Among these, Thinking AI, Mechanical AI and Feeling AI appeared in 45 studies, 23 studies and 15 studies, respectively. The selected studies span 34 journals and 28 countries, reflecting both the rising academic interest and the interdisciplinary character of this emerging field. However, this review also identifies notable deficiencies in the current body of work. This review integrates these AI types with the 4Ps framework to form a concise conceptual mapping of their respective functions. Although AI has been positioned as a powerful driver of green marketing, research remains fragmented, with limited assessment of AI's sustainability, weak data and ethical safeguards, and insufficient long-term and global perspectives. This underscores the need for a deeper and more systematic understanding of AI to better achieve the goals of green marketing and improve its practices.

**Keywords:** artificial intelligence; green marketing; sustainable development; sustainability; business management

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Academic Editors: Grigorios L. Kyriakopoulos, Judyta Kabus, Radosław Wolniak and Anna Brzozowska

Received: 1 October 2025
Revised: 6 November 2025
Accepted: 17 November 2025
Published: 20 November 2025

**Citation:** Mei, Y.; Geng, L.; Cao, X.; Xie, Y. Artificial Intelligence in Green Marketing: A Systematic Literature Review. *Sustainability* **2025**, *17*, 10382. https://doi.org/10.3390/su172210382

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## 1. Introduction

Environmental sustainability has risen to the top of the international policy agenda in recent decades and has been recognized as a key driving force for innovation [1]. With intensifying global warming and rising public awareness of ecological risks, green marketing has become a strategic response to the growing demand for sustainable development [2]. Driven by both regulatory pressures and consumer expectations [3], companies are being compelled to embed sustainability into their core marketing functions in order to secure long-term competitive advantage and environmental accountability [4]. More recently, Nohekhan and Barzegar [5] found that green marketing initiatives significantly enhance

brand awareness, consumer loyalty, and environmental trust based on a survey of 182 food exporter firms.

Green marketing refers to marketing activities that satisfy consumer needs while minimizing harm to the environment [6]. Definitions vary slightly across scholars but converge on key ideas: Peattie and Crane [7] emphasize minimal ecological damage; Grant [8] and Mohajan [9] classify green marketing as efforts in product planning, packaging, and promotion that reduce environmental impact. Since the term was first introduced by the American Marketing Association in the 1970s, green marketing has evolved into a core component of modern marketing strategies.

However, despite its growing relevance, traditional green marketing practices still face critical implementation challenges, three main challenges are listed as follows: When individuals experience embarrassment, they frequently turn to chatbots or other anonymous digital channels instead of direct interpersonal contact, which makes human-based support less effective in sensitive contexts [10]. In addition, many conventional strategies rely on broad demographic profiles or overly general assumptions about customer interests, which limits precise targeting and reduces message relevance [11]. Moreover, the production of green marketing campaigns continues to depend heavily on manual imagination and artistic effort. Designers need to gather data, develop concepts, and render them into visuals by hand, a process that remains slow and resource-intensive [12].

AI (abbr. of artificial intelligence), often referred to as machine intelligence, was originally developed to mimic human cognitive capabilities, allowing machines to perform tasks traditionally requiring human intellect [13,14]. The integration of AI offers remedies to the weaknesses of traditional green marketing. In consumer interactions, AI-driven conversational agents elicit more positive reactions when their replies adapt to users' emotional states [15], while the addition of social cues such as emojis further encourages audiences to continue engaging [16]. Beyond communication, by analyzing extensive datasets, AI systems can uncover patterns and hidden preferences, allowing firms to identify consumer groups with genuine interest in eco-friendly products or environmental lifestyles [11]. Generative AI also assists in detecting new green consumption trends and shifts in environmental awareness that may not be immediately visible to human analysts [10]. At the creative level, AI tools can markedly reduce the time and cost of campaign production. Through combining text-to-image generation with AI-based narrative design, companies can develop advertising storyboards in advance of full production, enhancing efficiency while retaining creative flexibility [12]. Taken together, these capabilities demonstrate how AI strengthens emotional connection, refines market targeting, and accelerates creative processes within green marketing.

In recent years, academic research at the intersection of AI and green marketing has grown steadily but it remains fragmented, such as the use of AI to optimize green logistics, support sustainable product innovation, or improve eco-friendly consumer profiling [17,18]. Consequently, although these works demonstrate the positive impact of AI on specific aspects of sustainability, they fall short of delivering a comprehensive and structured synthesis. The rapid evolution of AI has revolutionized traditional business practices, enabling data-driven decision-making, operational automation, and hyper-personalized consumer engagement [14]. With AI technologies diversifying and green marketing gaining increasing relevance under global environmental pressure, these developments make a systematic and integrative review necessary to clearly differentiate between AI categories or pair them with 4P strategies.

This study aims to conduct a systematic literature review (SLR) on AI applications in green marketing from 2020 to 2024, a period marked by significant advancements in both AI technologies and green marketing strategies. On 30 November 2022, OpenAI

launched ChatGPT (https://chatgpt.com, accessed on 1 February 2025), an AI-powered natural language processing tool that quickly gained popularity on social media. By late January 2023, ChatGPT's monthly active users had exceeded 100 million, making it the fastest-growing consumer application in history. During this time, there has been a growing emphasis on integrating AI into sustainability practices [19]. Grounded in Sustainability Marketing Theory, the review adopts Huang and Rust's (2019) three-fold classification of AI and maps these types onto the four pillars of green marketing [20]. A PRISMA-based screening process is employed to identify, classify, and analyze relevant academic publications. The key contribution of this study lies in its structured analytical framework, which enables a more precise understanding of how AI technologies align with specific marketing goals. Accordingly, this review is guided by two key questions:

RQ1: What are the application effects of different types of artificial intelligence technologies (Mechanical AI, Thinking AI, Feeling AI) in each link of green marketing?

RQ2: In terms of achieving the combination of academic research and practical applications, how can AI drive the future development of enterprises in the field of green marketing?

The remainder of this article is organized as follows. Section 2 presents the methodological framework and data collection criteria of this systematic review, outlining the PRISMA-based selection process and quality assessment approach. Section 3 summarizes the results of the bibliometrics analysis. Section 4 discusses the application of three types of AI across the four pillars of green marketing and provides practical insights for enterprise management. Section 5 concludes the paper by outlining the study's contributions, limitations, recommendations and directions for future research.

## 2. Methods

Methodologically, we used a five-step approach to conduct this systematic selection of peer-reviewed articles published following the PRISMA 2020 guidelines (Figure 1, Supplementary Materials). The steps are as follows:

Step 1: Establishing selection standards

Our search process mainly covered studies that explicitly combined artificial intelligence with green or sustainable marketing activities. During the search, preference was given to articles whose titles or abstracts clearly contained both AI and green marketing terms, which allowed us to exclude broader sustainability research without a marketing perspective. For the technical scope, we focused on the main AI typologies most relevant to marketing practice, including machine learning, deep learning, natural language processing, robotic process automation, and sentiment analysis.

Step 2: Determining search query

The search was conducted in three major academic databases: SpringerLink, Web of Science, and Google Scholar. SpringerLink is selected for its strong reputation in comprehensive coverage of high-quality and peer-reviewed literature with an interdisciplinary focus on AI, business, and marketing [21]. As one of the most widely used and highly respected databases in academic research, Web of Science provides access to a large array of interdisciplinary journals, including those in AI, green marketing, and business sustainability, ensuring only robust and credible sources are included in the review [22]. Although Google Scholar lacks the strict selection standards of the other two platforms, it was included due to its ability to capture a broad range of academic sources that may not be available through traditional academic databases, particularly in the areas of management and international business [23].

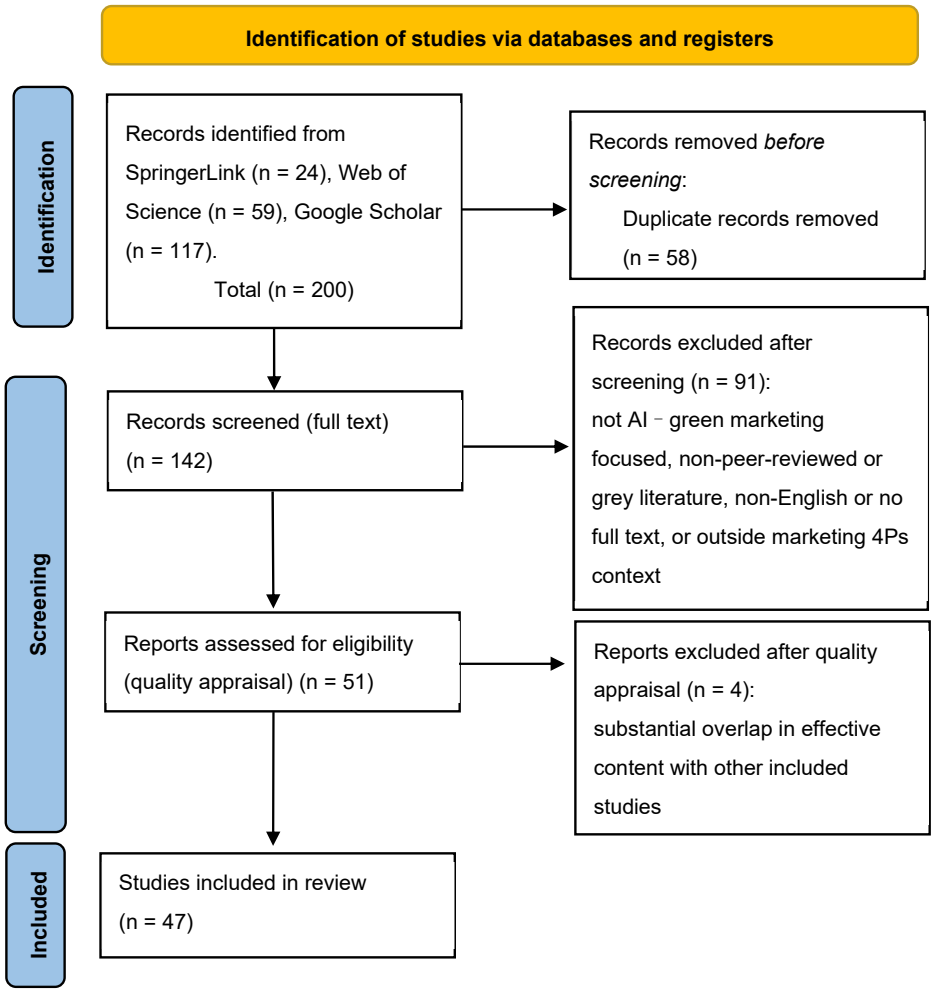


**Figure 1.** Literature Screening.

The time span was restricted to 1 January 2020–31 December 2024, with the last search performed in February 2025. For ensuring sufficient coverage of literature on the topic of study, previous reviews are also considered to ensure all relevant keywords are included in our search query [24,25].

We used both "AND" and "OR" operators to design a holistic search query. A Boolean search strategy was applied, combined terms related to AI and green marketing, structured as: ("Artificial Intelligence" OR "AI" OR "Machine Learning" OR "Deep Learning" OR "artificial neural networks" OR "ANN" OR "Neural Network" OR "Support Vector Machines" OR "Natural Language Processing" OR "Fuzzy cluster analysis" OR "evolutionary genetic algorithms" OR "genetic optimization" OR "fuzzy inference analysis" OR "genetic algorithm" OR "fuzzy logic") AND ("Thinking AI" OR "Predictive Analytics" OR "Decision Support Systems" OR "Mechanical AI" OR "Automation" OR "Robotic Process Automation" OR "Feeling AI" OR "Emotional AI" OR "Sentiment Analysis") AND ("Green Marketing" OR "Sustainable Marketing" OR "Eco-Marketing" OR "Environmental Marketing") AND ("Product" OR "Price" OR "Promotion" OR "Place" OR "4Ps").

Step 3: Screening and refinement

Records from each database were exported to Excel and appended into one sheet for duplicate removal. Then cross-source duplicates were removed using DOI match the journal version was retained where duplicate items occurred. The remaining ones were filed into a new single dataset. A two-phase screening was then conducted. In Phase 1, titles, abstracts, and keywords were reviewed to exclude irrelevant studies, non-English

publications, inaccessible full texts, and papers outside the AI–green marketing scope. In Phase 2, full-text screening was carried out to remove opinion pieces, editorials, and gray literature without methodological rigor. Only empirical and conceptual studies directly relevant to the research questions were retained.

Included studies had to focus on AI applications (e.g., machine learning, NLP, predictive analytics, emotional AI) in the context of green marketing, sustainable marketing, or environmental marketing, and explicitly link to at least one of the marketing mix elements (product, price, place, promotion).

Step 4: Final inclusion and quality assessment

The quality of the included studies was assessed using adapted criteria from established quality appraisal frameworks [26]. Two reviewers independently screened and extracted data from all eligible studies. Any discrepancies between reviewers were discussed and resolved by consensus to ensure consistency and accuracy in the inclusion process.

In this review, different quality evaluation questions were used to calculate the quality evaluation scores (see Table 1). Evaluation focused on aspects such as clarity of methods, validity of findings, discussion of AI's opportunities and risks, and comparability with prior studies. Each article received a quality score, and studies below the minimum threshold of 4.5/9 (50% of the maximum score) were excluded. This follows the 50% rule for inclusion adapted from Qamar et al. (2021) [25] and the use of predefined minimum QA criteria recommended by Idri et al. (2015) [26] for objective decisions. A higher threshold may lead to excessive exclusion, thereby diminishing sample representativeness; a lower threshold may dilute evidence quality and amplify bias, choosing the exact mid-scale boundary preserves objectivity and limits false exclusions in a heterogeneous field. The final set of articles formed the evidence base for subsequent content analysis.

**Table 1.** Quality Evaluation Criteria.

| QE | Evaluation Question(s) | 0 | 1 | 1.5 | 2 |
|---|---|---|---|---|---|
| QE1 | Is there an explicit discussion of data analysis methods? What type of analysis was employed? | No evidence | —— | Qualitative | Quantitative |
| QE2 | Are the challenges and advantages of AI applications in green marketing discussed? | No | Partially | Mostly | Yes |
| QE3 | Are the findings valid and aligned with the applied methods and research objectives? | No | Partially | Mostly | Yes |
| QE4 | Does the article have peer recognition and source reliability? | TC + H = 0 | $1 \leq$ TC + H $\leq 49$ | $50 \leq$ TC + H $\leq 100$ | TC + H > 100 |
| QE5 | Are the methods comparable to prior studies in AI-green marketing? | No | Partially | Mostly | Yes |

Note(s): TC = Total citations; H = H-index of the journal. Scores for QE1–QE5 are summed to calculate the total quality score (max 10). The above evaluation protocol was adapted from Qamar et al. (2021) [25], with modifications to fit the context of AI in green marketing studies as follows: QE1: Quantitative analysis: Defined as studies employing AI algorithms (e.g., machine learning models, NLP) or statistical tools (e.g., regression, SEM). Qualitative analysis: Includes case studies, interviews, or thematic analyses. QE2: Comprehensive discussion: Explicitly addresses both AI's potential (e.g., enhancing eco-efficiency) and limitations (e.g., data bias, ethical risks) in green marketing. QE3: Partial alignment and validation indicate limited or absent justification of how the applied method supports the reported results. QE4: Adjusted thresholds for TC + H to reflect the niche focus of AI-green marketing literature. QE5: Comparability is assessed against methods in prior AI-green marketing studies (e.g., predictive analytics for sustainable pricing).

Step 5: Content analysis and data synthesis

A narrative synthesis approach was applied to summarize and compare the findings across the included studies. For each included study, we extracted the following informa-

tion: author(s), year of publication, country of the first author, journal, AI type (Mechanical, Thinking, or Feeling), marketing dimension, research method, theoretical foundation, and main findings. Finally, the details gained from the content and data analyses will be synthesized and presented in Section 3 in tables and plots. Section 4 is organized by research questions: Section 4.1 answers RQ1 by summarizing the themes of three categories of AI applications within the 4Ps framework into a table; Section 4.2 answers RQ2 by synthesizing the practical applications of artificial intelligence in green marketing into a table.

## 3. Results

A comprehensive search was conducted across three major databases—SpringerLink, Web of Science and Google Scholar—for the period between 2020 and 2024. This initial search yielded a total of 200 records, comprising 24 from SpringerLink, 59 from Web of Science, and 117 from Google Scholar. After removing 58 duplicate records, 142 unique studies were retained for further screening.

The screening process was performed in two stages. First, 142 full-text records were reviewed, during which 91 studies were excluded because they did not focus on the intersection of artificial intelligence and green marketing, were non-peer-reviewed or gray literature, were not published in English, lacked full-text availability, or did not address at least one element of the marketing mix. After this stage, 51 articles remained and were subjected to quality evaluation.

During the eligibility assessment, the 51 retained articles were evaluated using the predefined quality appraisal criteria. Four studies were excluded at this stage because their effective content showed substantial overlap with other included publications, limiting their unique contribution. As a result, a total of 47 studies met the quality standards and were included in the final review sample.

The final set of 47 articles covered a wide range of applications of artificial intelligence in green marketing, reflecting the diversity of approaches and contexts within the field. These studies, published between 2020 and 2024 across 34 journals, involved 158 authors from 28 different countries, indicating a strong global interest and participation in AI-driven sustainability. The publication trend shows a steady increase from just three articles in 2020 to sixteen in 2024, highlighting the growing academic and practical relevance of this research domain (Figure 2).

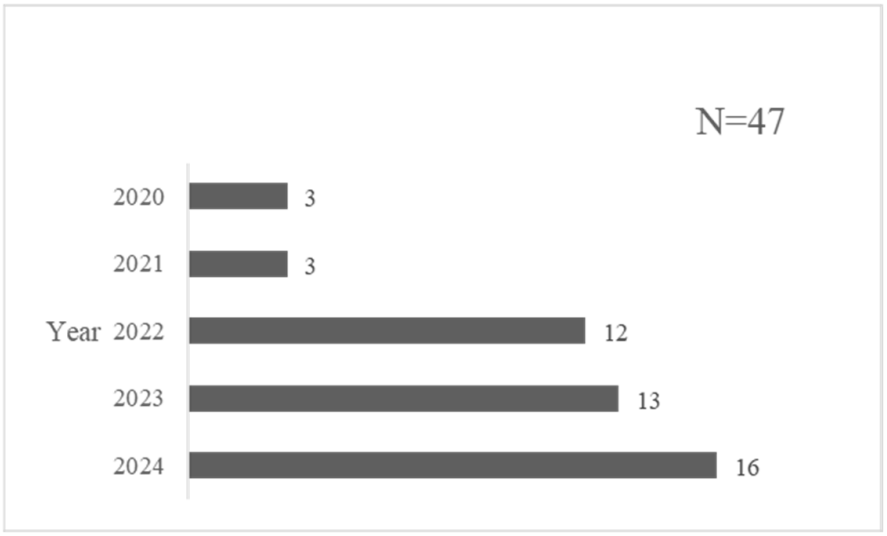


**Figure 2.** Annual Publication Trend (2020–2024). Note(s): Publication count for 2024 is inclusive of studies published and available online until January 2025.

Figure 3 indicates that scholars from China ($n$ = 15), India ($n$ = 5), and USA ($n$ = 5) are the main contributors, followed by Germany ($n$ = 4) and Russia ($n$ = 3). The high involvement of Chinese academics aligns with the country's strategic emphasis on green innovation and digital transformation. With the top ten countries cumulatively contributing approximately 73% of the total publications, this distribution suggests that both developed and developing countries are in an early state of leadership and active participation in the field of AI-driven green marketing.

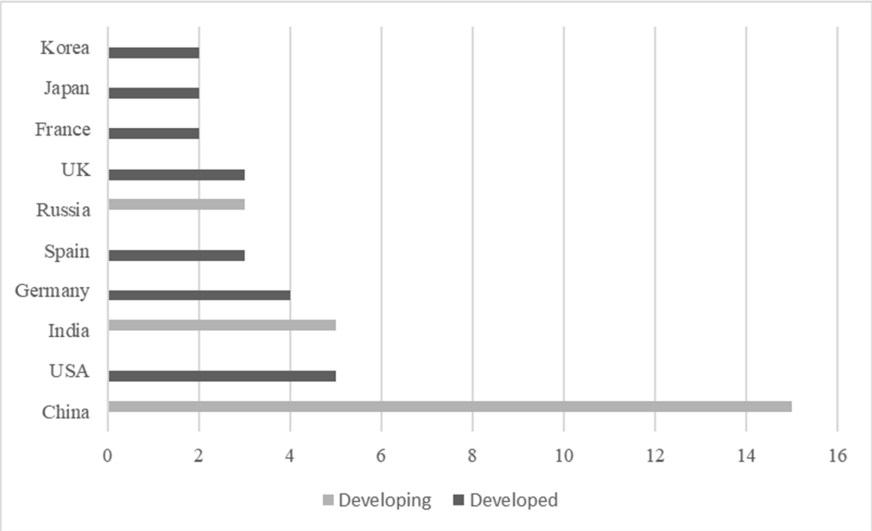


**Figure 3.** Contribution of Top 10 Countries Based on First Author Affiliation (According to the United Nations 2020 classification which is based on a United Nations document called UN M49).

To evaluate influence, citation metrics are applied. Table 2 presents the ten most cited articles within the corpus, accounting for both Total Citations (TC) and average citations per year (TC/year), indicating academic community is paying a high level of attention to supply chain efficiency, consumer engagement, and e-commerce field of AI and green marketing. The most cited study was by Ghahremani-Nahr et al., which received 176 citations with an average of 35.2 citations per year [27].

**Table 2.** Top 10 Most Cited Articles (TC and TC/year).

| Paper | Total Citations (TC) | TC per Year |
|---|---|---|
| Ghahremani-Nahr et al. (2021) [27] | 176 | 35.2 |
| Frank (2020) [28] | 152 | 25.33 |
| Liu-Thompkins et al. (2022) [29] | 143 | 35.75 |
| Turki, H., & Tlili, H. (2022) [30] | 121 | 30.25 |
| Chang et al. (2023) [31] | 101 | 33.67 |
| Zulaikha et al. (2020) [32] | 77 | 12.83 |
| Kar, A.K., & Kushwaha, A.K. (2021) [33] | 52 | 10.4 |
| Rowan et al. (2022) [34] | 47 | 11.75 |
| Rowan (2023) [35] | 46 | 15.33 |
| Shi et al. (2022) [36] | 33 | 8.25 |

In terms of journal influence, Journal of Cleaner Production emerged as the leading outlet, not only in publication volume but also with the highest H-index (309) among the journals represented. Other high-impact journals included IEEE Access (H-index 242) and

the Journal of the Academy of Marketing Science (H-index 207). The presence of these journals, many of which are not traditionally rooted in environmental or marketing studies, underscores the interdisciplinary nature of AI applications in green marketing (Figure 4).

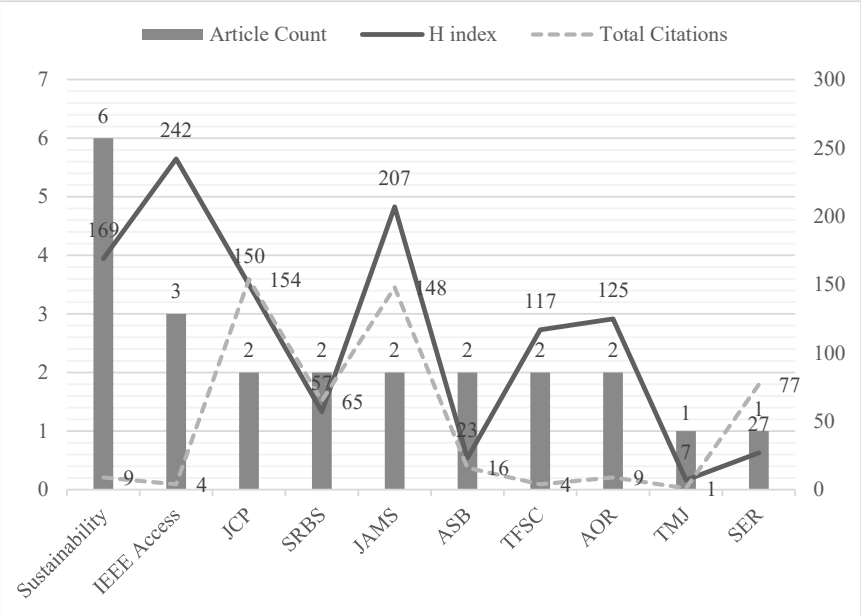


**Figure 4.** Ten Most Productive Journals by H-index. Note(s): The full-form of journal names abbreviations (sorted alphabetically) are as follows. JCP: Journal of Cleaner Production; SRBS: Systems Research and Behavioral Science; JAMS: Journal of the Academy of Marketing Science; ASB: Applied Sciences-Basel; TFSC: Technological Forecasting & Social Change; AOR: Annals of Operations Research; TMJ: Transnational Marketing Journal; SER: Singapore Economic Review. H index as per Scimago Journal and Country Rank (2024) retrieved from www.scimagojr.com, accessed on 1 February 2025; Total Citations as per the WOS Database.

## 4. Discussion

### *4.1. AI Application in Green Marketing*

The application of artificial intelligence in green marketing spans across all four dimensions of marketing (Table 3). Across the corpus, Thinking AI appeared in 45 studies, Mechanical AI in 23, and Feeling AI in 15. Rather than being confined to a single category, many studies illustrate how different types of AI are integrated simultaneously across multiple marketing areas. Mechanical AI automates routine tasks such as data collection, thinking AI processes data to generate insights for strategic decisions, and feeling AI analyzes emotional data to enhance customer interactions [19].

#### 4.1.1. Mechanical AI Applications in Green Marketing

For Product. Mechanical AI supports eco-efficient product design by automating precision manufacturing processes, minimizing waste, and enhancing quality control. In the agri-food sector, smart sensors and IoT devices were employed to monitor variables such as temperature and humidity, reducing spoilage and ensuring consistency in product quality [37]. Similarly, automated robotic systems in ecological agriculture regulate irrigation and fertilization, optimizing water and nutrient use while lowering environmental impact [36]. In aquaculture, automated feeding systems regulate nutritional distribution, minimizing excess feed and associated pollution while maintaining uniform product quality [35]. Cobots and visual inspection systems were implemented in automotive and OEM sectors to detect micro-defects, reduce rework, and align production with sustainabil-

ity standards [38]. These examples demonstrate how Mechanical AI enables precision, repeatability, and sustainability in green product design and manufacturing.

**Table 3.** AI-Green Marketing Cross-Analysis matrix.

| | **Mechanical AI (*n* = 23)** | **Thinking AI (*n* = 45)** | **Feeling AI (*n* = 15)** |
|---|---|---|---|
| Product | • Automated quality inspection (e.g., robotics, sensors) enhances green product consistency and reduces waste<br>• Automated data collection across production stages supports green lifecycle analysis<br>• IoT and robotic systems improve emission control and real-time monitoring | • Machine learning supports green product innovation via eco-trend detection, lifecycle analysis, and personalization<br>• Predictive analytics aid in smart product design for circular economy goals<br>• AI enables green self-identification and user preference alignment | • Emotion-aware personalization aligns green products with user identity and values<br>• Wearable data or self-identity markers inform sustainable product recommendations |
| Price | • AI-based automation reduces operational costs and integrates environmental cost metrics into dynamic pricing<br>• Predictive maintenance and resource efficiency lower pricing pressure | • AI pricing algorithms internalize environmental costs and support eco-premium strategies<br>• Demand forecasting and cost modeling promote sustainability-aligned pricing | • Emotional feedback data informs premium justification for eco-products<br>• Consumer sentiment helps forecast willingness to pay for sustainability |
| Place | • Automated logistics (e.g., route optimization, smart warehousing) reduce carbon emissions and improve eco-distribution<br>• Real-time tracking systems enhance transparency in reverse logistics and supply chains | • AI optimizes green supply chain logistics, including route planning and emission minimization<br>• Supports eco-alliances and spatial efficiency | • AR/VR experiences and emotion-driven design foster connection to green distribution systems<br>• Emotion-targeted logistics communication enhances eco-branding |
| Promotion | • Automated sustainability reporting tools support transparent promotion<br>• Mechanical systems streamline environmental certification communication | • NLP and sentiment analysis enable personalized sustainability messages<br>• Explainable AI boosts trust in promotional transparency<br>• Smart content engines adapt messaging to eco-conscious values | • Affective computing and emotional segmentation enhance green campaign resonance<br>• Real-time emotional feedback fine-tunes sustainability narratives |

Note(s): Frequencies reflect the number of distinct mentions across marketing dimensions. Article counts are non-exclusive. Studies covering multiple marketing dimensions are counted more than once.

For Price. Mechanical AI indirectly enables sustainable pricing through resource and energy efficiency improvements. Real-time monitoring systems such as predictive maintenance tools in food manufacturing can lower downtime and energy waste, reducing operational costs and supporting affordable pricing for green offerings [37]. In ecological

production, cloud-based automation platforms have led to a 20% reduction in marketing costs, demonstrating how backend efficiency translates into competitive pricing structures [39]. Furthermore, AI-driven systems dynamically adjust resource allocation to balance production efficiency with environmental considerations. For instance, automated systems in aquaculture and precision farming optimize energy and input use, pricing green products in a sustainable way while remaining competitive [36,40].

For Place. Mechanical AI applications in logistics and distribution focus on optimizing resource flows and minimizing environmental burdens. Computer vision and IoT-based logistics systems enable real-time route optimization, reducing fuel consumption and emissions during transportation [37]. In aquaculture logistics, robotic underwater monitoring devices help maintain environmental conditions across marine cages, supporting sustainable spatial management of aquatic ecosystems [35]. Smart warehousing technologies, such as AI-controlled inventory systems and automated placement mechanisms, have been shown to reduce energy consumption and improve delivery accuracy [41]. In broader manufacturing sectors, automated reverse logistics systems support product recovery and reuse, further contributing to circular economy goals and enhancing the environmental performance of green placing [42].

For Promotion. Mechanical AI also plays a role in scaling green promotion through automation of communication workflows and environmental reporting. Automated sustainability dashboards disseminate real-time environmental data across digital channels, reinforcing brand transparency and stakeholder trust [33]. In hospitality and agriculture sectors, IoT-enabled feedback systems track environmental performance (e.g., water or feed usage) and channel this information to consumers as part of the product narrative [43]. Furthermore, automated campaign engines schedule green promotional content and email dissemination, reducing manual labor while maintaining consistent sustainability messaging [44]. These tools strengthen the firm's capacity to deliver clear and reliable environmental communication at scale.

#### 4.1.2. Thinking AI Applications in Green Marketing

For Product. Thinking AI is extensively applied in green product innovation and lifecycle design. In the financial and agri-food sectors, machine learning models such as Random Forest and Gradient Boosting are employed to analyze customer behavior, uncovering preferences like Green Self-Identity (GSI) and eco-consciousness to guide product features [45,46]. Convolutional Neural Networks (CNNs) also aid in product quality monitoring, especially in food and aquaculture industries, detecting defects and optimizing green production practices [35,37]. Other studies apply hybrid algorithms, such as CNN-LSTM and EA-ANN, which can optimize resource usage and reduce environmental footprints during manufacturing [36,47]. These models allow firms to adjust product designs based on lifecycle assessments, reducing waste and emissions. Moreover, expert systems and fuzzy reasoning enable green radical innovation (GRI) by integrating internal knowledge with external data to support sustainable research and development directions [33,44].

For Price. In pricing strategy, Thinking AI supports sustainability through algorithmic integration of environmental cost metrics and consumer willingness to pay. Optimization models such as Random Search or IHHO-LSTM allow firms to adjust prices by simulating trade-offs between carbon reduction and operational costs [48,49]. AI-enhanced pricing logic incorporates real-time data to shape eco-adjusted price points [50]. In consumer markets, pricing tools using NLP and big data mining evaluate behavioral cues to propose value-aligned prices. For instance, dynamic pricing matrices process data on customer preferences, allowing ethical price positioning for sustainable offerings [32,51]. These models help firms ensure affordability while maintaining environmental transparency.

For Place. Thinking AI contributes significantly to green logistics and sustainable distribution planning. Algorithms such as Dijkstra's and NSGA-III are used to plan low-emission transport routes in real time, minimizing fuel consumption and aligning with city-level carbon restrictions [52]. Predictive analytics also optimize delivery networks and manage inventory distribution to reduce waste from overstocking or inefficient transportation [53,54]. Blockchain combined with AI ensures transparency across logistics chains, aiding eco-alliance evaluations and improving green compliance [41,43]. In retail and platform-based situations, AI further enhances place efficiency by identifying optimal channels for eco-product promotion, reducing environmental impact of misaligned marketing [39].

For Promotion. Thinking AI plays a strategic role in green promotion by enabling explainable, logic-based messaging tailored to environmentally aware consumers. Sentiment analysis, predictive modeling, and hybrid recommendation systems allow firms to deliver targeted narratives based on values like recyclability, health, and ethical sourcing [29,53]. For example, time-aware recommender algorithms have demonstrated high precision in pushing sustainable food products to users based on evolving sentiment patterns [55]. Explainable AI systems also support transparency in sustainability claims, making marketing efforts more credible and engaging. Cognitive modeling techniques help segment users based on values and behaviors, enabling micro-targeted green advertisements [35,56]. Moreover, simulation-based frameworks help structure promotional pricing and messaging strategies that resonate with eco-conscious motivations [33,57].

#### 4.1.3. Feeling AI Applications in Green Marketing

For Product. In the production process, Feeling AI plays a pivotal role in aligning offerings with consumers' emotional identities and values. Numerous studies embed GSI as a key emotional construct driving eco-friendly purchase behavior. Choudhury et al. [45] demonstrated that machine learning models incorporating GSI and environmental consciousness significantly enhance personalization of green product design, guiding firms to tailor offerings that resonate with users' desire to be perceived as environmentally responsible. Similarly, Manta et al. [58] and Chang et al. [46] inferred consumer eco-values through emotional data analysis, supporting design strategies for sustainable financial and food products. Su et al. [44] used wearable health data to customize nutritional content in eco-food production, emphasizing personal well-being and environmental impact.

For Price. Though less common, the price-related applications of Feeling AI can help capture the emotional basis for premium green pricing. For example, sentiment-informed models by Mu et al. [49] integrated news-based emotional indices to refine carbon credit price forecasts, suggesting that positive affect enhances consumer acceptance of green premiums. Ethical farming transparency was shown to evoke emotional trust, supporting willingness to pay for animal-welfare-certified products [40]. Choudhury et al. [45] also observed that emotional narratives of linking higher prices to ecological benefits increase environmentally conscious consumers' justification towards sustainable pricing.

For Place. Feeling AI applications in green logistics are emerging through immersive technologies and emotional feedback systems. Ding et al. [37] integrated AR/VR environments to practices supply chain sustainability, fostering emotional connection to brands via virtual transparency. Cillo and Rubera [57] pointed out that marketers can use GenAI's scenario generation capabilities to simulate personalized delivery scenarios aligned with consumer emotional profiles, increasing engagement with green distribution systems. These tools not only visualize environmental impact but also engage users empathetically in low-carbon consumption journeys.

For Promotion. Promotion is the most focused area for Feeling AI, where emotional resonance is crucial for effective green information transmission. Studies such as Rowan [35]

and Kar & Kushwaha [33] found that AI-driven storytelling, particularly through social media sentiment analysis and adaptive messaging, enables firms to craft narratives centered on pride, empathy, and collective responsibility. For example, Jauhar et al. [41] reported that affective chatbots improved customer participation in sustainability programs by fostering perceived sincerity and environmental commitment. Alharbi [50] showed that Airbnb hosts who emotionally framed descriptions such as 'eco-friendly stay' in listings experienced enhanced consumer engagement and pricing flexibility. In parallel, Mohammadian & Valilai [56] used Python-based (https://www.python.org, accessed on 1 February 2025) sentiment tracking to refine influencer messaging, mitigating negative consumer sentiment and reinforcing green brand identity.

### *4.2. Practical Integration of AI in Green Marketing*

While academic research has laid a strong foundation for understanding how AI technologies can support green marketing, the key challenge ahead lies in translating these insights into real-world practices that businesses can implement. To address this, we must consider how each type of AI can be practically integrated into daily operations by different types of firms and roles across industries (Table 4).

**Table 4.** AI-Green Marketing Practices matrix.

| Business Type | Preferred AI Type | Suggested Applications |
| --- | --- | --- |
| Manufacturing | Mechanical AI | Automated energy control, green production management |
| E-commerce/Retail | Feeling AI | Green content creation, emotion-driven recommendation systems |
| Agriculture/Food | Thinking AI | Smart sowing, green product configuration |
| Brands | Thinking + Feeling AI | Emotional green advertising; logical green pricing |
| Logistics Companies | Mechanical + Thinking AI | Automated scheduling; route optimization for emission reduction |

#### 4.2.1. Mechanical AI: Automating Infrastructure of Green Marketing

Manufacturing and logistics enterprises should prioritize evaluating the existing production and logistics processes that can be replaced by automation to identify potential areas for energy conservation and emissions reduction, and invest in relevant hardware or software systems as a priority.

For manufacturing firms, deploying industrial robots and IoT sensors can help improve energy efficiency and reduce waste. Green manufacturing companies should consider implementing smart production lines (e.g., IoT sensors combined with robotic arms) to monitor and control energy and water consumption in real-time. Research by Ding et al. [37] demonstrated systems enhance the consistency of sustainable product manufacturing.

In the logistics and e-commerce industries, technologies such as unmanned delivery and automated warehousing can help cut carbon emissions. Medium-sized logistics companies could integrate AI-driven route optimization systems [44] using GIS technology to reduce empty miles and improve energy efficiency in their operations.

In terms of job responsibilities, company operations managers should regularly review and adjust AI system parameters to ensure that they align with energy-saving standards. Warehouse supervisors should learn how to maintain automated storage systems properly in order to avoid unnecessary energy loss and production downtime.

#### 4.2.2. Thinking AI: Supporting Green Strategy Decisions

For enterprises focusing on sustainable product design or pricing, incorporating AI tools like Life Cycle Analysis (LCA) and optimization algorithms can provide critical support. Brands should collaborate with technical teams to integrate these academic models into ERP or marketing automation systems.

Commerce businesses could adopt decision tree models [51] for real-time eco-adjusted pricing, where carbon footprint is factored into product pricing to reflect sustainability efforts transparently. Kar & Kushwaha [33] proposed that AI can personalize green product recommendations based on user data, optimizing both the customer.

For agricultural or food companies, AI can assist in smart agricultural practices, optimizing sustainable farming practices and green product decisions. Agricultural businesses should integrate AI models for optimizing sowing and fertilization plans based on real-time weather forecasts and pest predictions [36]. This could improve resource efficiency and reduce unnecessary waste.

In the operational aspect, data scientists should focus on building models for LCA and carbon pricing simulations to support sustainable product and pricing decisions. Marketing analysts should also integrate sustainable metrics into their targeting and segmentation logic, and use structured AI tools to match customers with suitable eco-friendly products.

#### 4.2.3. Feeling AI: Building Emotional Green Appeal

For companies that rely heavily on consumer interaction, using sentiment analysis tools and emotion-recognition systems can allow them to create more personalized, emotionally resonant green marketing strategies. These approaches not only enhance brand loyalty but also strengthens consumer trust in the brand's commitment to sustainability.

In beauty, food and beverage brands, sentiment analysis and emotion recognition tools are leveraged to adjust green packaging designs or promotional messages according to consumer emotional responses. Brands in consumer-facing industries can deploy emotion recognition systems to monitor customer sentiment on social media. For example, Maarif et al. [59] demonstrated "green purchasing motivations" through VADER analysis of green food evaluation that could help businesses refine their communication strategies.

Through real-time AI emotion recognition technology, E-commerce platforms can personalize product recommendations and tailor promotional content to resonate with consumers' emotional triggers. Combined with the AI expression recognition to regulate the emotional intensity of advertising mechanism proposed by Liu-Thompkins et al. [29], E-commerce platforms can utilize AI to adjust the tone and style of green marketing content based on real-time customer feedback.

For corporate employees, customer service representatives need to understand how to interpret emotional analysis results to optimize content style in real-time, ensuring alignment with consumers' environmental concerns. While brand communication officials should apply AI-driven tools, such as sentiment analysis software, to mediate green marketing messages, ensuring they are both emotionally engaging and environmentally responsible.

## 5. Conclusions

This review systematically examines the role of artificial intelligence in advancing green marketing through an analysis of 47 peer-reviewed studies published between 2020 and 2024. The findings indicate that three distinct types of AI play complementary yet differentiated roles in this domain. Mechanical AI, leveraging automation and sensor technology, supports sustainable product design, energy-conscious pricing, and green logistics, thereby forming the operational foundation of green marketing initiatives. Thinking AI, powered by predictive modeling, optimization algorithms, and lifecycle assessment, is cen-

tral to strategic decision-making in product development, pricing, and distribution. Feeling AI, supported by sentiment detection and emotional computing, enhances the emotional value and trust in green brand communication, particularly strengthening promotional efforts and customer resonance.

Although research on artificial intelligence in green marketing has gained momentum in recent years, this review reveals several structural limitations in the current literature. Subsequent work should therefore proceed more systematically along the following lines:

1. The environmental sustainability of AI itself has not been fully discussed. While AI is often portrayed as an enabler of environmental solutions, its own energy consumption, reliance on large-scale data infrastructures, and associated carbon emissions are rarely assessed. The absence of such evaluations undermines the integrity of claims positioning AI as inherently "green," and calls for more critical reflection on the life-cycle impacts of AI applications. Researchers are encouraged to assess the environmental costs associated with AI itself. Investigating the energy consumption, infrastructure requirements, and emissions resulting from AI applications would allow for a more accurate evaluation of their net contribution to sustainability. Future research should develop assessment frameworks to determine whether AI-based green marketing practices genuinely reduce environmental impact or simply shift burdens to other parts of the value chain.
2. While numerous studies rely on large-scale data modeling, they frequently overlook critical issues such as data bias, lack of standardized practices, insufficient algorithmic transparency, and inadequate privacy protection [30,50]. Scholars should propose transparent data collection protocols, establish human oversight mechanisms in algorithmic decision-making processes, and design governance frameworks to ensure AI applications in green marketing align with ethical standards and accountability requirements [60]. Research in this area can help ensure that AI systems are trusted by consumers and compliant with evolving standards of digital ethics.
3. Studies with long-term and global perspectives are still lacking. Existing research pays little attention to the cumulative economic, environmental, and social impacts of AI-driven green strategies over time [44,56]. Geographically, the literature is heavily concentrated in countries like China, the United States, and India, with limited attention to developing economies or regions with different cultural contexts [31,42,44]. This limits the global applicability of current AI-based green marketing solutions [30,50]. Future research should adopt longitudinal and comparative studies to explore the sustainable role of AI in different cultural and regulatory environments. This will help expand its applicability in less developed regions and developing economies, driving the global adoption of green marketing.

The findings of this review should be interpreted in light of several limitations. Although a systematic and transparent approach was adopted, the restriction to three major databases and the use of predefined keywords may have led to the omission of some relevant studies, excluding gray literature and inaccessible full texts may contribute to publication bias. The limitation in the extraction process is that records from different databases were exported and manually merged into a single dataset. This step involved removing duplicates primarily based on DOI matching, which may not account for all variations in data formats or missing DOI fields. Furthermore, despite efforts to ensure methodological rigor, potential subjectivity in data interpretation cannot be completely ruled out. As this study primarily provides an integrative overview rather than quantitative synthesis, future research could employ meta-analytic techniques to generate stronger evidence on the effects of AI applications in green marketing.

In response to RQ1, this study adopts a three-part framework, Mechanical AI, Thinking AI, and Feeling AI to systematically categorize and compare how each type of AI is applied across the four pillars of green marketing. This classification addresses the lack of both clear technological differentiation and cross-dimensional comparison in prior studies, and extends the conceptual integration between AI capabilities and sustainable marketing strategy.

In relation to RQ2, this study proposes a three-dimensional mapping framework linking AI types, marketing functions, and organizational roles. This framework clarifies the structural relationships between AI technologies and green marketing practices, offering a practical foundation for future research on how enterprises can embed AI into their green strategies.

Enterprises should adapt to the characteristics of AI, provide capability retraining for managers and implementers, and establish cross-departmental collaboration mechanisms to achieve the coordinated promotion of green strategy and technological innovation. Firstly, manufacturing and logistics enterprises should focus on the infrastructure value of Mechanical AI, such as deploying automated sensing equipment, intelligent detection systems, and energy-saving robots, to improve the efficiency of green production lines and reduce carbon emissions and material waste. Secondly, agricultural, retail, and platform-based enterprises can focus on deploying Thinking AI to assist in product structure adjustment, green pricing formulation, and channel resource allocation through LCA, optimization algorithms, and intelligent pricing models. For fast-moving consumer goods, cosmetics and e-commerce companies that rely on user interaction, Feeling AI should be used for stimulating green resonance and emotional identification through emotion recognition, public opinion analysis, and personalized recommendation systems.

For policymakers, we recommend (1) tightening standards for environmental claims and AI transparency in marketing, including auditable documentation of data sources, model logic, and guardrails; (2) mandating minimum disclosure of AI energy or compute use and associated emissions for customer-facing campaigns aligned with LCA reporting; (3) requiring privacy-by-design and bias auditing for targeting and pricing models, with proportionate enforcement; (4) creating targeted incentives for verifiably low-carbon, explainable AI applications in marketing.

In summary, this review not only synthesizes existing research but also opens up more systematic and multidimensional theoretical and managerial perspectives on the role of AI in advancing green marketing.

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su172210382/s1, PRISMA 2020 Checklist. Reference [61] are cited in the Supplementary Materials.

**Author Contributions:** Conceptualization, Y.M.; methodology, Y.M.; validation, X.C. and Y.X.; formal analysis, Y.M.; investigation, Y.M.; resources, X.C. and Y.X.; data curation, Y.M. and L.G.; writing—original draft preparation, Y.M.; writing—review and editing, X.C. and Y.X.; visualization, Y.M.; supervision, X.C. and Y.X.; project administration, X.C. and Y.X.; funding acquisition, X.C. and Y.X. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was supported by the Jiangsu Provincial Federation of Philosophy and Social Sciences (22SCB-12), Quality evaluation and improvement countermeasures of carbon information disclosure of high carbon emission enterprises; the National Natural Science Foundation of China (72501125), Research on portfolio optimization based on dynamic neural networks and large-model enhancement; and the Basic Research Program of Jiangsu (BK20251589).

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Data will be made available upon reasonable request from the corresponding authors.

**Conflicts of Interest:** The authors declare no conflicts of interest.

## References

1. Dangelico, R.M.; Vocalelli, D. "Green Marketing": An analysis of definitions, strategy steps, and tools through a systematic review of the literature. *J. Clean. Prod.* **2017**, *165*, 1263–1279. [CrossRef]
2. Nidumolu, R.; Prahalad, C.K.; Rangaswami, M.R. Why sustainability is now the key driver of innovation. *Harv. Bus. Rev.* **2009**, *87*, 56–64.
3. Singh, S.P. The Green Revolution In Marketing—Is It Worth? In Proceedings of the 11th Annual Convention of Strategic Management Forum, Indian Institute of Technology (IIT), Kanpur, India, 8–10 May 2008.
4. Polonsky, M.J. An introduction to green marketing. *Electron. Green J.* **1994**, *1*, 1–10. [CrossRef]
5. Nohekhan, M.; Barzegar, M. Impact of green marketing strategy on brand awareness: Business, management, and human resources aspects. *arXiv* **2024**, arXiv:2401.02042. [CrossRef]
6. Coddington, W. *Environmental Marketing*; McGraw-Hill: New York, NY, USA, 1993.
7. Peattie, K.; Crane, A. Green marketing: Legend, myth, farce or prophesy? *Qual. Mark. Res. Int. J.* **2005**, *8*, 357–370. [CrossRef]
8. Grant, J. Viewpoin Green Marketing. *Strateg. Dir.* **2008**, *24*, 25–27. [CrossRef]
9. Mohajan, H. Aspects of green marketing: A prospect for Bangladesh. *Int. J. Econ. Res.* **2012**, *3*, 1–11.
10. Diwanji, V.S.; Geana, M.; Pei, J.; Nguyen, N.; Izhar, N.; Chaif, R.H. Consumers' Emotional Responses to AI-Generated versus Human-Generated Content: The Role of Perceived Agency, Affect and Gaze in Health Marketing. *Int. J. Hum.-Comput. Interact.* **2025**, *41*, 12270–12290. [CrossRef]
11. Darban, K.; Kabbaj, S.; El Jay, M. The Transformative Potential of AI in Green Marketing Strategies. *Tradit. J. Law Soc. Sci.* **2023**, *2*, 14–38.
12. Chaisatitkul, A.; Luangngamkhum, K.; Noulpum, K.; Kerdvibulvech, C. The power of AI in marketing: Enhancing efficiency and improving customer perception through AI-generated storyboards. *Int. J. Inf. Technol.* **2024**, *16*, 137–144. [CrossRef]
13. Min, H. Artificial intelligence in supply chain management: Theory and applications. *Int. J. Logist. Res. Appl.* **2010**, *13*, 13–39. [CrossRef]
14. Jia, Q.; Guo, Y.; Li, R.; Li, Y.; Chen, Y. A conceptual artificial intelligence application framework in human resource management. In Proceedings of the International Conference on Electronic Business (ICEB), Guilin, China, 2–6 December 2018; Volume 2018, pp. 106–114.
15. Ham, J.; Li, S.; Looi, J.; Eastin, M.S. Virtual humans as social actors: Investigating user perceptions of virtual humans' emotional expression on social media. *Comput. Hum. Behav.* **2024**, *155*, 108161. [CrossRef]
16. Yan, H.; Wei, Y.; Xiong, H. How do initial and interactive social cues increase customers' continuance usage intention of chatbots? *Int. J. Hum.-Comput. Interact.* **2025**, *41*, 4700–4717. [CrossRef]
17. Zhu, Q.; Sarkis, J. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *J. Oper. Manag.* **2004**, *22*, 265–289. [CrossRef]
18. Dahlstrom, R. *Green Marketing Management, International Edition*; South-Western/Cengage Learning: Southbank, VIC, Australia, 2011.
19. van Wynsberghe, A. Sustainable AI: AI for sustainability and the sustainability of AI. *AI Ethics* **2021**, *1*, 213–218. [CrossRef]
20. Huang, M.H.; Rust, R.T.; Maksimovic, V. The feeling economy: Managing in the next generation of artificial intelligence (AI). *Calif. Manag. Rev.* **2019**, *61*, 43–65. [CrossRef]
21. Gusenbauer, M. Search where you will find most: Comparing the disciplinary coverage of 56 bibliographic databases. *Scientometrics* **2022**, *127*, 2417–2442. [CrossRef]
22. Falagas, M.E.; Pitsouni, E.I.; Malietzis, G. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and weaknesses. *FASEB J.* **2008**, *22*, 338–342. [CrossRef]
23. Harzing, A.-W.K.; van der Wal, R. Google Scholar as a new source for citation analysis. *Ethics Sci. Environ. Polit.* **2008**, *8*, 105–120. [CrossRef]
24. Bhardwaj, S.; Nair, K.; Tariq, M.U.; Ahmad, A.; Chitnis, A. The state of research in green marketing: A bibliometric review from 2005 to 2022. *Sustainability* **2023**, *15*, 2988. [CrossRef]
25. Qamar, Y.; Agrawal, R.K.; Samad, T.A.; Jabbour, C.J. When technology meets people: The interplay of artificial intelligence and human resource management. *J. Enterp. Inf. Manag.* **2021**, *34*, 1339–1370. [CrossRef]
26. Idri, A.; Amazal, F.A.; Abran, A. Analogy-based software development effort estimation: A systematic mapping and review. *Inf. Softw. Technol.* **2015**, *58*, 206–230. [CrossRef]
27. Ghahremani-Nahr, J.; Nozari, H.; Sadeghi, M.E. Green supply chain based on artificial intelligence of things (AIoT). *Int. J. Innov. Manag. Econ. Soc. Sci.* **2021**, *1*, 56–63. [CrossRef]

28. Frank, B. Artificial intelligence-enabled environmental sustainability of products: Marketing benefits and their variation by consumer, location, and product types. *J. Clean. Prod.* **2021**, *285*, 125242. [CrossRef]
29. Liu-Thompkins, Y.; Okazaki, S.; Li, H. Artificial empathy in marketing interactions: Bridging the human–AI gap in affective and social customer experience. *J. Acad. Mark. Sci.* **2022**, *50*, 1198–1218. [CrossRef]
30. Turki, H.; Tlili, H. Bibliometric Analysis of Artificial Intelligence in Services and Marketing: Identifying Research Perspectives. *Transnatl. Mark. J.* **2024**, *12*, 118–145.
31. Chang, L.; Taghizadeh-Hesary, F.; Mohsin, M. Role of artificial intelligence on green economic development: Joint determinates of natural resources and green total factor productivity. *Resour. Policy* **2023**, *82*, 103508. [CrossRef]
32. Zulaikha, S.; Mohamed, H.; Kurniawati, M.; Rusgianto, S.; Rusmita, S.A.R. Customer predictive analytics using artificial intelligence. *Singap. Econ. Rev.* **2021**, *70*, 1–12. [CrossRef]
33. Kar, A.K.; Kushwaha, A.K. Facilitators and barriers of artificial intelligence adoption in business—Insights from opinions using big data analytics. *Inf. Syst. Front.* **2023**, *25*, 1351–1374. [CrossRef]
34. Rowan, N.J.; Murray, N.; Qiao, Y.; O'Neill, E.; Clifford, E.; Barceló, D.; Power, D.M. Digital transformation of peatland eco-innovations ('Paludiculture'): Enabling a paradigm shift towards the real-time sustainable production of 'green-friendly' products and services. *Sci. Total Environ.* **2022**, *838*, 156328. [CrossRef]
35. Rowan, N.J. The role of digital technologies in supporting and improving fishery and aquaculture across the supply chain—Quo Vadis? *Aquacult. Fish.* **2023**, *8*, 365–374. [CrossRef]
36. Shi, Y.; Lin, Y.; Lim, M.K.; Tseng, M.L.; Tan, C.; Li, Y. An intelligent green scheduling system for sustainable cold chain logistics. *Expert Syst. Appl.* **2022**, *209*, 118378. [CrossRef]
37. Ding, H.; Tian, J.; Yu, W.; Wilson, D.I.; Young, B.R.; Cui, X.; Xin, X.; Wang, Z.; Li, W. The application of artificial intelligence and big data in the food industry. *Foods* **2023**, *12*, 4511. [CrossRef] [PubMed]
38. Moniz, A.B.; Candeias, M.; Boavida, N. Changes in productivity and labour relations: Artificial intelligence in the automotive sector in Portugal. *Int. J. Automot. Technol. Manag.* **2022**, *22*, 222–244. [CrossRef]
39. Jia, D.; Wu, Z. Development model of enterprise green marketing based on cloud computing. *Wirel. Commun. Mob. Comput.* **2022**, *2022*, 4931374. [CrossRef]
40. Neethirajan, S. Artificial intelligence and sensor technologies in dairy livestock export: Charting a digital transformation. *Sensors* **2023**, *23*, 7045. [CrossRef]
41. Jauhar, S.K.; Harinath, S.; Krishnaswamy, V.; Paul, S.K. Explainable artificial intelligence to improve the resilience of perishable product supply chains by leveraging customer characteristics. *Ann. Oper. Res.* **2024**, *354*, 103–142. [CrossRef]
42. Bawack, R.E.; Wamba, S.F.; Carillo, K.D.A.; Akter, S. Artificial intelligence in E-Commerce: A bibliometric study and literature review. *Electron. Mark.* **2022**, *32*, 297–338. [CrossRef]
43. Lubag, M.; Bonifacio, J.; Tan, J.M.; Concepcion, R., II; Mababangloob, G.R.; Galang, J.G.; Maniquiz-Redillas, M. Diversified impacts of enabling a technology-intensified agricultural supply chain on the quality of life in hinterland communities. *Sustainability* **2023**, *15*, 12809. [CrossRef]
44. Su, H.; Qu, X.; Tian, S.; Ma, Q.; Li, L.; Chen, Y. Artificial intelligence empowerment: The impact of research and development investment on green radical innovation in high-tech enterprises. *Syst. Res. Behav. Sci.* **2022**, *39*, 489–502. [CrossRef]
45. Choudhury, N.; Mukherjee, R.; Yadav, R.; Liu, Y.; Wang, W. Can machine learning approaches predict green purchase intention? A study from Indian consumer perspective. *J. Clean. Prod.* **2024**, *456*, 142218. [CrossRef]
46. Chang, V.; Hahm, N.; Xu, Q.A.; Vijayakumar, P.; Liu, L. Towards data and analytics driven B2B-banking for green finance: A cross-selling use case study. *Technol. Forecast. Soc. Chang.* **2024**, *206*, 123542. [CrossRef]
47. Han, Z.; Zhu, X.; Su, Z. Forecasting maritime and financial market trends: Leveraging CNN-LSTM models for sustainable shipping and China's financial market integration. *Sustainability* **2024**, *16*, 9853. [CrossRef]
48. Huang, R.; Mao, S. Carbon footprint management in global supply chains: A data-driven approach utilizing artificial intelligence algorithms. *IEEE Access* **2024**, *12*, 89957–89967. [CrossRef]
49. Mu, G.; Dai, L.; Ju, X.; Chen, Y.; Huang, X. MS-IHHO-LSTM: Carbon price prediction model of multi-source data based on improved swarm intelligence algorithm and deep learning method. *IEEE Access* **2024**, *12*, 89957–89967. [CrossRef]
50. Alharbi, Z.H. A Sustainable Price Prediction Model for Airbnb Listings Using Machine Learning and Sentiment Analysis. *Sustainability* **2023**, *15*, 13159. [CrossRef]
51. Wang, Y.; Liu, P.; Zhu, K.; Liu, L.; Zhang, Y.; Xu, G. A garlic-price-prediction approach based on combined LSTM and GARCH-family model. *Appl. Sci.* **2022**, *12*, 11366. [CrossRef]
52. Cheng, Y. Analysis of development strategy for ecological agriculture based on a neural network in the environmental economy. *Sustainability* **2023**, *15*, 6843. [CrossRef]
53. Tang, Y.M.; Chau, K.Y.; Lau, Y.Y.; Zheng, Z. Data-intensive inventory forecasting with artificial intelligence models for cross-border e-commerce service automation. *Appl. Sci.* **2023**, *13*, 3051. [CrossRef]

54. Jin, K.; Zhong, Z.Z.; Zhao, E.Y. Sustainable digital marketing under big data: An AI random forest model approach. *IEEE Trans. Eng. Manag.* **2024**, *71*, 3566–3579. [CrossRef]
55. Geng, H.; Peng, W.; Shan, X.G.; Song, C. A hybrid recommendation algorithm for green food based on review text and review time. *CyTA-J. Food* **2023**, *21*, 481–492. [CrossRef]
56. Mohammadian, N.; Fatahi Valilai, O. Influencer-driven paradigm shifts: Analyzing sustainability and customer behavior in cell phone and e-auto industries via social media analytics. *IEEE Access* **2024**, *12*, 119133–119145. [CrossRef]
57. Cillo, P.; Rubera, G. Generative AI in innovation and marketing processes: A roadmap of research opportunities. *J. Acad. Mark. Sci.* **2024**, *52*, 119133–119145.
58. Manta, A.G.; Bădîrcea, R.M.; Doran, N.M.; Badareu, G.; Gherțescu, C.; Popescu, J. Industry 4.0 transformation: Analysing the impact of artificial intelligence on the banking sector through bibliometric trends. *Electronics* **2024**, *13*, 1693. [CrossRef]
59. Maarif, M.R.; Syafrudin, M.; Fitriyani, N.L. Uncovering sustainability insights from amazon's eco-friendly product reviews for design optimization. *Sustainability* **2024**, *16*, 172. [CrossRef]
60. Bartelt, C.; Röser, A.M. Artificial intelligence as a catalyst for sustainable business innovation: Perspectives from finance and marketing. *Gazdaság És Társadalom* **2024**, *35*, 37–65. [CrossRef]
61. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* **2021**, *372*, n71. [CrossRef]


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