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A REVIEW OF AI-ENABLED SUSTAINABLE MARKETING STRATEGIES: OPPORTUNITIES, RISKS, AND FUTURE DIRECTIONS

YAPAY ZEKÂ DESTEKLİ SÜRDÜRÜLEBİLİR PAZARLAMA STRATEJİLERİNİN İNCELENMESİ: FIRSATLAR, RİSKLER VE GELECEKTEKİ YÖNELİMLER

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Abstract
Nowadays, increasing environmental awareness and consumer consciousness have also increased the importance given to green marketing. Thus sustainable brand processes, guided by global dynamics such as Sustainable Development Goals have become pivotal strategy for green marketing. Simultaneously, digital transformation spearheaded by artificial intelligence (AI), big data and the Internet of Things (IoT) is reshaping this field. This study presents a narrative literature review synthesising academic work from 2010 to 2025 obtained from the ScienceDirect and Google Scholar databases. This article examines the intersection of sustainability and digital innovation through thematic content analysis, highlighting key focus areas such as strategic integration, AI tools (e.g., chatbots, machine learning), changing consumer behaviour, and ethical challenges. The study demonstrates how new technologies offer opportunities for businesses to maintain their competitive advantage while winning over environmentally conscious consumers and promoting environmental responsibility. Furthermore, the study emphasises that ethical, transparency, privacy, and trust elements are vital for the sustainability of consumer relationships. Ultimately, this research draws attention to the balance between technological innovation and human-centred management, offering a comprehensive perspective on the future of AI-supported green marketing.
Keywords: Green marketing, sustainability, artificial intelligence, digital transformation, consumer engagement, SDGs

Özet
Yeşil pazarlama; artan çevre bilinci ve Sürdürülebilir Kalkınma Hedefleri (SKH) gibi küresel dinamiklerin etkisiyle, sürdürülebilir markalaşma sürecinde kritik bir strateji haline gelmiştir. Eş zamanlı olarak; yapay zeka (YZ), büyük veri ve Nesnelerin İnterneti (IoT) öncülüğündeki dijital dönüşüm, bu alanı yeniden şekillendirmektedir. Bu çalışma, ScienceDirect ve Google Scholar veri tabanlarından elde edilen 2010-2025 yılları arasındaki akademik çalışmaları sentezleyen anlatımsal bir literatür taraması sunmaktadır. Tematik içerik analizi aracılığıyla sürdürülebilirlik ve dijital inovasyonun kesişim noktasını inceleyen bu makale; stratejik entegrasyon, YZ araçları (ör. sohbet robotları, makine öğrenimi), değişen tüketici davranışları ve etik zorluklar gibi temel odak

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noktalarını ortaya koymaktadır. Yapılan inceleme, yeni teknolojilerin işletmelere rekabet avantajını korurken çevreye duyarlı tüketicileri kazanma ve çevresel sorumluluğu teşvik etme konusunda nasıl fırsatlar sunduğunu göstermektedir. Bununla birlikte çalışma; tüketici ilişkilerinin sürdürülebilirliği açısından etik, şeffaflık, gizlilik ve güven unsurlarının hayati önem taşıdığını vurgulamaktadır. Sonuç olarak bu araştırma; teknolojik inovasyon ile insan merkezli yönetim arasındaki dengeye dikkat çekerek, YZ destekli yeşil pazarlamanın geleceğine dair kapsamlı bir perspektif sunmaktadır.
Anahtar kelimeler: Yeşil pazarlama, sürdürülebilirlik, yapay zeka, dijital dönüşüm, tüketici katılımı, (SKA)

1. Introduction

Green marketing has emerged as a critical pillar of sustainable branding, emphasizing the promotion of products and services based on their environmental and social benefits (Polonsky, 1994; Mei et al., 2025; Zhou & Jiang, 2025). Strategies such as the use of sustainable materials, carbon-neutral operations, and recycling initiatives not only address rising consumer demand for eco-friendly offerings but also reinforce a company's image as a socially responsible brand. As climate change, environmental degradation, and resource scarcity intensify, stakeholders—including consumers, investors, and regulators—increasingly demand transparency, ethical accountability, and measurable sustainability outcomes (Su & Li, 2024). By integrating ecological values into core business operations, companies can enhance their competitive advantage and meet regulatory requirements while contributing to global sustainability efforts.

Concurrently, rapid digital transformation is revolutionizing the marketing landscape. Emerging technologies such as Artificial Intelligence (AI), Big Data Analytics, Internet of Things (IoT), and generative AI are reshaping how sustainability is communicated, personalized, and scaled (Vlačić et al., 2021; Kshetri et al., 2024). These innovations offer unprecedented capabilities in customer profiling, real-time engagement, and impact measurement, allowing marketers to craft more precise and authentic green messaging (Baruno, 2025). Consequently, these innovations in digital marketing plays a crucial role in enhancing sustainability by addressing key challenges such as customer orientation, digital consumer behavior, and the integration of green marketing strategies. And green marketing is also evolving from niche ethical appeals to a data-driven strategy with the potential to accelerate progress toward the United Nations Sustainable Development Goals (SDGs) and digital marketing (Vinuesa et al., 2020; Gündüzyeli, 2024).

Despite the growing interest in both domains, limited research examines the specific intersection where AI-driven tools explicitly enhance sustainable consumer behavior. A clear gap remains in understanding integrated, technology-enabled green marketing frameworks and

their measurable impact on transparency. To address this gap, this study presents a narrative literature review covering the period from 2010 to 2025. By synthesizing academic research obtained from ScienceDirect and Google Scholar, this paper aims to identify key digital tools driving green marketing, assess the influence of digital strategies on sustainable consumer behaviors, and highlight challenges and opportunities at the convergence of technology and sustainability. This synthesis contributes to the growing recognition that digital transformation is a vital catalyst for achieving the SDGs, offering insights for leveraging innovation as an enabler for responsible marketing practices.

1. Methodology

1.1. Research design and data collection

"*Narrative reviews are studies that synthesise the findings, conclusions and evaluations of two or more published works on a specific topic by conducting an analysis of them".* (Burns & Grove, 2009). This study adopts a narrative literature review approach aiming to synthesize the integration of Artificial Intelligence (AI) into green marketing strategies. To ensure a comprehensive coverage of the topic, a structured search was conducted using primary academic databases including ScienceDirect and Google Scholar in our study.

The search strategy employed specific keywords to capture relevant studies. Our search words included combinations of: ("Green Marketing" OR "Sustainable Marketing") AND ("Artificial Intelligence" OR "AI" OR "Digital Transformation" OR "Machine Learning") AND ("Consumer Behavior" OR "Sustainability"). The literature search covered the period from 2010 to 2025, allowing for the inclusion of foundational studies while focusing heavily on recent technological advancements in this field.

1.2. Inclusion and exclusion criteria

The inclusion and exclusion criteria detailed below were used to determine which studies would be included in the scope of the research:

Inclusion Criteria: (1) The articles must be peer-reviewed academic articles published in English; (2) They must directly address the intersection of digital technologies/artificial intelligence with environmental sustainability within the discipline of marketing; (3) They must

focus on consumer engagement, strategic marketing, or operational efficiency within a green context.

Exclusion Criteria: (1) Sources lacking academic merit, such as blog posts or magazines; (2) Studies that do not address marketing applications but only examine artificial intelligence techniques; (3) Duplicate publications or research containing methodological uncertainties.

1.3. Data analysis and synthesis

The identified literature was subjected to a thematic content analysis. At first, abstracts were screened for relevance and then selected full-text articles were reviewed to identify recurring themes, emerging trends, and research gaps. The synthesis of this data was organized into key thematic clusters, which form the subsequent sections of this review: (1) Strategic integration of green marketing, (2) AI tools and applications, (3) Consumer behavior shifts, and (4) Global challenges in the age of AI and sustainability. This structured approach ensures a holistic view of how smart technologies are reshaping sustainable marketing practices. The prosed research model can be seen in Figure 1 below.

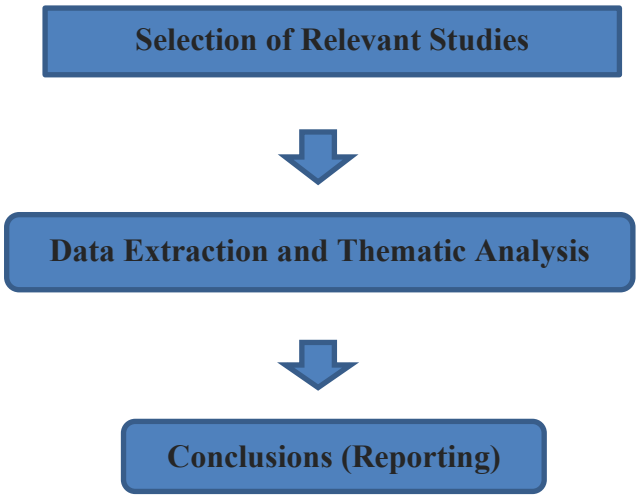

Figure 1. Research Model

As mentioned above, following the literature review conducted using keywords, the selected relevant studies were examined through thematic analysis and reported under the following headings.

2. Evolution and research trajectory of green marketing

The rising tide of consumer environmentalism has transformed green marketing from a niche concept into a strategic imperative. Early on, McDaniel and Rylander (1993) emphasized that environmental responsibility represents a fundamental paradigm shift rather than a fleeting trend, requiring deep integration into corporate marketing frameworks. They argued that companies must move beyond superficial claims; instead, genuine environmental values should be embedded in organizational culture, product development, and communication channels. By aligning these ecological commitments with broader business objectives, firms can achieve distinct brand differentiation and foster enduring customer loyalty, treating sustainability as a proactive strategic driver rather than a mere reaction to external pressure. Building on this foundation, Chamorro et al. (2009) provided a comprehensive historical analysis of the field's 'evolutionary changes.' Drawing on key publications such as Business Strategy and the Environment and Corporate Social Responsibility & Environmental Management, their review mapped out dominant research themes while highlighting significant methodological gaps. Ultimately, their study advocates for a redirection in future scholarship, urging researchers to explore dimensions of the field that have traditionally been overlooked.

3. Integrating sustainability across the marketing mix

Since its emergence in the 1980s, green marketing has matured from a specialized niche into a fundamental strategic asset for companies seeking a competitive edge in an environmentally conscious marketplace. Beyond being merely an ethical obligation, sustainability is now recognized as a potent market differentiator that permeates every aspect of the marketing mix—from eco-friendly design and manufacturing to logistics and waste management. However, this transition is not without its challenges; Arseculeratne and Yazdanifard (2014) highlight significant barriers such as navigating complex regulations, overcoming consumer skepticism regarding 'green' claims, and the absolute necessity of rigorous transparency. To address these issues, effective green marketing must be built upon three core pillars: transparency,

authenticity, and consumer education. As the market evolves, Rathore (2018) suggests that the most successful brands will be those that embrace circular economy models and leverage technology to verify their environmental impact, thereby transforming informed purchasing decisions into enduring customer loyalty.

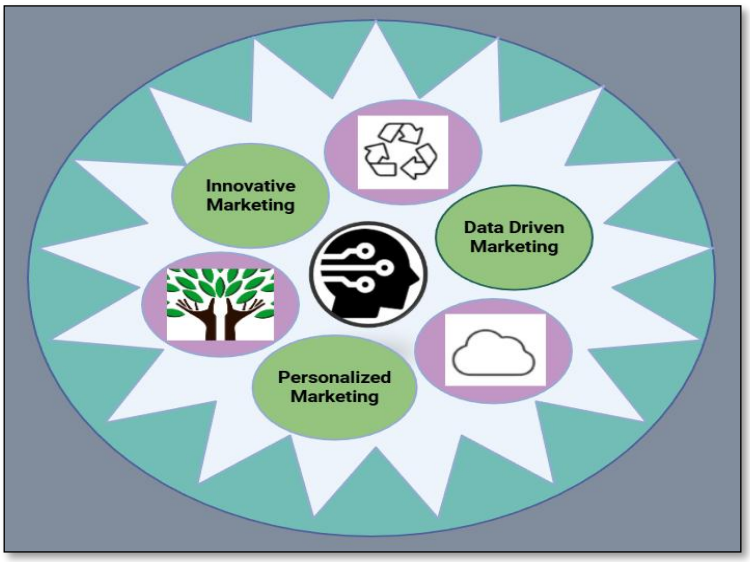

Figure 2: Integration of sustainability, AI, and green marketing for customers

Focusing on emerging markets, one study examined consumer responses in Ghana to green marketing strategies implemented via the SDGs. Surveying 622 respondents structurally modeled, the research found significant positive links between green marketing, consumer behavior, and brand loyalty, mediated by price sensitivity. Young Ghanaian consumers, in particular, are driven by eco-conscious messaging, an important insight for firms seeking brand strength in emerging economies (Amoako et al., 2022). Another study analyzed green marketing strategies within Iran's food industry. Using fuzzy-Delphi and SWARA methods, researchers distilled 12 key green marketing strategies aligned with 23 sustainability criteria. Multi-criteria decision-making (MCDM) tools, including ARAS, COPRAS, TOPSIS, and VIKOR, revealed top priorities: waste-reduction technologies, green consumer research, and recyclable production materials. These findings support R&D investment and tailored environmental campaigns in developing contexts, though additional methods (e.g., DEMATEL and fuzzy-BWM) may enhance analytical precision (Esmaelnezhad et al., 2023). Broadening the lens, a bibliometric review of 1,252 green marketing articles (2004-2024) using VOSviewer identified six thematic clusters: green consumerism, brand attributes, strategic approaches,

economic/business perspectives, climate/eco context, and education/supply chain/tourism. Over time, green marketing research has intensified, particularly in India, China, and Malaysia, among leading publication venues. The study emphasized collaboration across business, education, and government sectors to advance sustainable practice frameworks, notwithstanding a slight dip in publications in early 2024 (Sumarsono et al., 2025).

Green marketing has firmly taken root across key sectors, particularly in the food, beverage, and textile industries. Through a comprehensive PRISMA-guided review of 54 articles, Cui et al. (2025) mapped the landscape of this trend, identifying core themes such as eco-branding, circular economy principles, and the pivotal role of cultural integration in fashion. Their analysis goes beyond surface-level trends to highlight the critical necessity of closed-loop systems, logistics efficiency, and zero-waste manufacturing. To drive these sustainability transitions, the authors advocate for the adoption of blockchain technology to ensure transparency, alongside robust consumer education. Furthermore, the review suggests that fostering stronger academia–industry partnerships is essential for developing evaluation standards, noting that embedding cultural innovation into design significantly amplifies a brand's green appeal (Cui et al., 2025).

4. Strategic green marketing in emerging economies

Green marketing has evolved from a regulatory compliance mechanism into a strategic imperative that reflects growing global environmental consciousness. As climate change, pollution, and sustainability dominate public discourse, businesses are reimagining their marketing practices to align with eco-conscious values. Across developed and developing markets, this shift is redefining consumer behavior, branding strategies, and long-term business planning. Polonsky (2011) critiqued the current limitations of green marketing, arguing that its minimal impact on both consumer well-being and environmental preservation stems from a lack of systems thinking. He called for a transformative approach that redefines value to include environmental costs and emphasized macro-level environmental integration into micro-level business decisions. For green marketing to be truly effective, Polonsky proposed three actions: rethinking how value is measured and communicated, enhancing environmental literacy, and shifting consumer focus from material acquisition to meaningful consumption. The study underscored that marketers have a crucial role in reframing the discourse around consumption, advocating for durable, modular, and upgradable products rather than disposable trends.

In India and other emerging economies, green marketing is gaining prominence due to rising consumer awareness and regulatory pressure. Jyoti (2013) emphasized that consumers increasingly prefer products from environmentally responsible companies, and in many cases are willing to pay a premium for such offerings. However, she also highlighted the shared responsibility between consumers and producers, noting that consumer behaviors often exacerbate environmental degradation. Businesses, she argues, must not only market sustainable practices but also actively educate and empower consumers to make environmentally conscious decisions. Echoing this, Saini (2014) pointed out that green marketing is no longer limited to niche segments but is rapidly becoming a mainstream strategy. Companies must meet consumer expectations around environmental stewardship, balancing performance and affordability without compromising sustainability. Transparency, consumer education, and government regulation are seen as essential for ensuring trust and accountability in green product claims.

In another context, Mishra and Sharma (2014) emphasized avoiding "green marketing myopia," urging companies to apply strong marketing fundamentals that make green products appealing and relatable. They argued that effective green marketing requires more than compliance or trend-following; it must foster meaningful engagement with environmental challenges. Positioning green products as superior alternatives, supported by third-party certifications and credible messaging, is key to earning consumer trust. Saxena and Khandelwal (2009) focused on empirical insights from India and found that consumers are increasingly receptive to green branding, packaging, and advertising. Their study stressed the importance of well-defined standards for green products to combat misleading claims. Successful initiatives from companies like GE and Dell highlight how integrating environmental and business goals can result in a competitive advantage. The authors called for further research into consumer perceptions, especially in developing economies, to refine strategies and promote broader adoption. Collectively, these studies affirm that green marketing is more than a promotional tool; it is a multifaceted strategy that demands systemic thinking, authenticity, consumer involvement, and policy alignment. While challenges like cost, misinformation, and infrastructure gaps remain, the path forward lies in embedding sustainability across all business functions and redefining success in both economic and environmental terms.

Table 1: Strategic green marketing with technology for consumers

Major Outcomes	References
Authentic incorporation of sustainability into branding and product development strengthens brand identity and long-term loyalty while reducing greenwashing risks. Requires a deep restructuring around environmental and social responsibility, supported by technological innovations and robust corporate social responsibility strategies.	Bobojonova (2025)
Integration of environmental responsibility into core business strategies improves cost efficiency, brand reputation, customer loyalty, and positions green marketing as a driver of sustainable development.	Arseculeratne & Yazdanifard (2014)
AI-enabled Customer Relationship Management (CRM) transforms marketing operations through automation, predictive analytics, and real-time personalized customer engagement, requiring new marketing models.	Dirican (2015)
AI-driven marketing enhances the adoption of renewable energy solutions via precise targeting, personalized communication, and data-driven recommendations as a critical enabler of green innovation and public awareness.	Al-Ababneh et al. (2025)
AI applications improve access to essential services and support SDG achievement, while highlighting the need for ethical governance and capacity building through management education, ethical frameworks, and strategic cross-sector collaboration.	Goralski & Tan (2020)
AI-enabled marketing in retail optimizes supply chains, reduces emissions, and promotes responsible consumption aligned with SDGs.	Salhab et al. (2025)
IoT-based green marketing increases environmental awareness and consumer intention to purchase eco-friendly products through real-time, interactive communication.	Tu et al. (2017)
Generative AI strengthens brand–consumer relationships through predictive insights and personalized content, enhancing satisfaction, loyalty, and sustainable growth.	Roy (2025)

5. Artificial intelligence and the future of marketing education and practice

AI is transforming the marketing landscape by demonstrating how brands interact with consumers, how data is processed, and how strategic decisions are made. As AI technologies mature, their applications in marketing, from customer engagement to predictive analytics, are becoming more sophisticated, nuanced, and critical to competitive success. At the core of AI's impact lies its ability to process vast amounts of data to derive actionable insights. Haleem et al. (2022) underscored AI's role in enhancing real-time targeting, customer segmentation, and campaign optimization through machine learning (ML) and adaptive algorithms. These tools enable the delivery of personalized content across optimal channels, improving customer satisfaction and purchasing decisions. Language-based AI, such as chatbots and voice

assistants, is streamlining customer experiences, guiding users through purchase journeys, and enhancing post-sale interactions.

However, the true potential of AI in marketing extends beyond automation and personalization. Huang and Rust (2021) proposed a three-tier AI framework: mechanical, thinking, and feeling AI, each corresponding to different stages of marketing: research, strategy, and action. Mechanical AI handles automation tasks: thinking AI supports data-driven personalization; and feeling AI, though still emerging, interprets customer emotions for relational marketing. Despite limitations, such as mechanical AI's inability to capture emotional context, the framework serves as a strategic roadmap for marketers to align AI capabilities with their business objectives. AI's increasing role has also sparked a shift in marketing education. Grewal et al. (2025) advocated for the integration of generative AI into foundational marketing curricula to prepare students for a tech-driven job market. AI-powered simulations can be used to teach segmentation, targeting, positioning (STP), and consumer profiling, while tools like ChatGPT can replicate focus groups in research classes. The authors highlighted that while the benefits of AI-enhanced learning are substantial, institutional support is critical for successful curriculum transformation.

From an industry-wide perspective, Espina-Romero et al. (2023) conducted a bibliometric analysis of AI applications across sectors between 2018 and 2022. Their study revealed significant AI adoption in sectors like healthcare, finance, and construction, with Europe and Asia leading the charge. Within marketing, AI's integration has enabled more efficient supply chains, hyper-personalized communications, and sustainability-focused innovation. Future opportunities include deploying AI in energy systems and renewable technologies, highlighting its role in driving both economic and environmental progress. In high-tech ventures, AI's impact on performance is closely tied to the scale and depth of adoption. Lee et al. (2022) found that minimal investment in AI yields negligible results. However, firms that invest substantially, especially when supported by complementary technologies like cloud computing, experience considerable revenue growth. Strategic internal R&D further amplifies these benefits. The study underscored that a holistic AI adoption strategy is essential for meaningful business outcomes. Kartajaya et al. (2019) observed that digital technologies have rendered the classical 4A model, Aware, Attitude, Act, and Act Again, obsolete. Modern customer journeys are no longer linear but multidirectional, influenced by real-time digital touchpoints and personalized content. AI

enables brands to navigate this complexity by continuously engaging customers across diverse platforms.

A systematic review by Desta and Amantie (2024) further affirmed AI's contributions to market performance. Analyzing 45 articles, the study highlighted AI's role in demand forecasting, pricing optimization, risk analysis, and decision-making. AI-driven strategies increase customer satisfaction and loyalty while driving sustainable growth. This growing body of literature signals a shift toward data-centric, predictive, and real-time marketing approaches. Verma et al. (2021) provided a comprehensive bibliometric analysis of over 1,500 papers on AI in marketing. Their study identified three conceptual phases in the evolution of AI literature: early exploration, contextual application, and advanced integration with technologies like big data and neural networks. The research outlined five intellectual clusters, ranging from trust-based marketing to data-driven consumer insights. These findings offer a foundational framework for future academic inquiry and practical innovation.

Despite AI's potential, it is not without risks, particularly in terms of trust, power asymmetries, and ethical implications. Grewal et al. (2021) explored both the bright and dark sides of AI in B2C and B2B contexts. In B2C markets, consumer distrust stems from concerns over data privacy and opaque algorithms. In B2B settings, power imbalances and concentrated control over data raise strategic and ethical concerns. The study called for more transparent, equitable, and responsible AI practices across all business domains. Ethical considerations are further explored by Du and Xie (2021), who examined AI-enabled products through a socio-technical lens. The authors identified multi-functionality, interactivity, and intelligence level as key factors influencing ethical outcomes. Issues like algorithmic bias, autonomy loss, and job displacement challenge consumer trust and societal well-being. Their proposed AI-specific CSR framework encourages firms to embed ethical safeguards into product design, organizational behavior, and industry standards. Companies that address these concerns proactively are more likely to earn consumer trust and ensure sustainable innovation. Collectively, these studies present AI as both a disruptive force and a strategic enabler in marketing. Its applications span from hyper-personalization and customer journey optimization to ethical decision-making and sustainable innovation. The integration of AI in marketing requires a balanced approach, one that recognizes its transformative potential while actively addressing its limitations.

6. Customer experience in ai-enabled marketing

The role of AI in personalized marketing was examined, focusing on its impact on customer interaction, predictive segmentation, and brand engagement. AI enhances marketing effectiveness through automation, real-time data analysis, and personalized content delivery, enabling firms to track consumer behavior and deliver targeted messaging that boosts engagement and conversion rates (Bano et al., 2025). Tools like AI-powered chatbots and virtual assistants improve customer service experiences, fostering trust and long-term loyalty. Companies such as Amazon and Netflix exemplify the effective use of predictive analytics to anticipate customer needs and drive satisfaction. Similarly, Bhardwaj et al. (2024) emphasized how AI-driven personalization technologies, such as machine learning, recommender systems, and natural language processing, transform digital marketing by improving targeting precision, reducing cart abandonment, and enhancing conversion rates. These tools allow marketers to adapt quickly to dynamic consumer behavior while supporting ethical imperatives like transparency, data privacy, and user control.

The chapter also stressed the importance of maintaining customer trust amid increasing regulatory demands. Complementing these findings, Hassan et al. (2025) used Structural Equation Modeling (SEM) to analyze how AI-based personalized recommendations influence trust, satisfaction, and loyalty in e-commerce. The study confirmed that trust significantly boosts satisfaction and loyalty, with personalization acting as a positive moderator. However, it warns that poorly designed personalization can erode consumer trust, underscoring the importance of ethical, explainable AI systems. Collectively, these studies highlighted that while AI can significantly improve decision-making and customer relationships, sustainable success requires ethical alignment, user transparency, and responsible data governance. Businesses that integrate AI thoughtfully, balancing innovation with human-centered values, are better positioned to cultivate loyalty and maintain a competitive edge in an evolving digital marketplace.

7. Consumer behavior in ai-driven marketing

Technological innovation continues to reshape marketing strategies and consumer behavior, demanding that businesses adapt swiftly and strategically. A qualitative literature review by Kumar et al. (2024) revealed that advancements in information and communication

technologies have transformed how firms engage consumers, deliver value, and stay competitive. Success in this evolving landscape requires digital fluency, data-driven personalization, and real-time responsiveness. Marketers must integrate AI and social media into their strategies while prioritizing consumer privacy to foster trust and loyalty. As marketing shifts from traditional approaches to behavior-driven, technology-enabled models, investment in staff training and analytical skills becomes essential. Expanding on this technological shift, Phuangsuwan et al. (2024) explored AI's growing role in supporting sustainable development. Through a systematic review of literature from 2020 to 2024, the study showed how AI can forecast eco-conscious behaviors, guide demographic-specific marketing, and help businesses design sustainable products. AI also enhances efficiency in logistics and production, aligning operations with green consumer expectations. However, the authors cautioned against unethical uses of AI, such as greenwashing or promoting overconsumption, and stressed the need for responsible data use and ethical algorithm design. Together, these studies affirm that while technology drives marketing innovation, ethical and strategic foresight are essential for long-term success and sustainability.

8. Alignment of artificial intelligence and sustainable development

AI is increasingly positioned at the forefront of global sustainability initiatives, offering both transformative opportunities and significant risks. Across industries and regions, AI is shaping the way organizations, governments, and communities work toward the United Nations SDGs. However, as adoption accelerates, so too must critical evaluation of AI's ethical, environmental, and societal implications. Vinuesa et al. (2020) conducted a consensus-based analysis revealing that while AI can positively influence 134 SDG targets, such as improving agriculture, healthcare, and education, it also risks negatively impacting 59 others. Key concerns include algorithmic bias, job displacement, deepening digital divides, and the misuse of AI for political manipulation. The study warned that without adequate regulation and oversight, AI may disproportionately benefit the affluent while marginalizing under-resourced communities. Expanding on this theme, Kulkov et al. (2024) identified three critical areas, organizational, technical, and processing, where AI contributes to sustainability. Their conceptual model stresses strategic alignment, infrastructure development, and stakeholder engagement as foundational for effective AI integration. Importantly, the study highlighted the fragmented

nature of existing research and calls for more interdisciplinary collaboration, particularly on ethical governance and energy consumption.

In a regional context, Jankovic and Curovic (2023) analyzed AI adoption among 240 firms in Serbia and the broader West Balkans. Their findings showed that companies leveraging AI in data management and digital customer engagement report improved efficiency, innovation, and transparency in sustainability reporting. High adopters gain a competitive advantage, while low adopters face increasing disadvantages. Yet challenges remain, namely cost, technical complexity, and privacy concerns. To unlock AI's full potential, the study advocated for improved digital infrastructure and ethical governance aligned with Environmental, Social, and Governance (ESG) standards. AI is also emerging as a powerful tool in environmental modelling, especially in the tourism sector. Duvnjak et al. (2020) underscored AI's ability to enhance forecasting, sustainability analysis, and decision-making in tourism development. The authors highlight AI's role in simulating complex human-environment dynamics, supporting better planning to prevent environmental degradation. However, given the multi-stakeholder nature of tourism and its dependence on both natural and man-made resources, the study cautions against a one-size-fits-all approach.

From a business innovation perspective, Xiao and Su (2022) explored the role of technological innovation in advancing environmental and social sustainability through a survey of Chinese SMEs. Their research confirmed that a positive attitude toward technological innovation significantly influences organizational innovation, which in turn supports sustainable practices. Interestingly, digital entrepreneurship did not show a significant mediating effect, suggesting that future research should examine the contextual factors that enhance or limit the sustainability potential of emerging technologies. AI's environmental impact is not negligible. Khajeh and Nouhi (2023) conducted qualitative interviews with experts from various sectors and identified five key themes: direct environmental impacts, mitigation strategies, technological innovation, policy and regulation, and public awareness. The study calls attention to the energy-intensive nature of AI systems and the importance of sustainable design, renewable energy integration, and digital literacy. It emphasized that the responsible deployment of digital technologies is crucial to minimizing their environmental footprint. Leal Filho et al. (2023) reinforced this view, presenting AI as a critical enabler of sustainable innovation across multiple domains, including transportation, agriculture, and public health. Their work demonstrated that AI could improve decision-making and system efficiencies,

contributing to a more equitable and sustainable future. Case studies and global survey data affirmed that AI must be integrated thoughtfully to avoid unintended consequences and maximize societal benefits.

Despite AI's potential, Nasir et al. (2023) found a pronounced imbalance in how AI initiatives align with the SDGs. By analyzing curricula, frameworks, and research projects, the study revealed that AI efforts are disproportionately focused on SDG 9 (Industry, Innovation, and Infrastructure), which appeared in over half the documents reviewed. Meanwhile, goals related to gender equality, clean water, marine life, and biodiversity were severely underrepresented. The authors argued for a more inclusive, balanced approach to AI development that supports all three sustainability pillars: economic, social, and environmental. This imbalance is particularly evident in sectors like construction, where Regona et al. (2024) explored AI's role in promoting sustainable practices. Through a review, the study mapped AI applications across the construction lifecycle, from planning to maintenance, and identified their alignment with key SDGs such as clean energy (SDG 7), sustainable cities (SDG 11), and climate action (SDG 13). While AI can optimize resource use and reduce environmental impacts, challenges like data privacy, workforce reskilling, and technical complexity must be overcome. The paper provided a roadmap for industry stakeholders to responsibly transition toward AI-enabled sustainability. At a more systemic level, Satornino et al. (2024) developed a Responsible AI Deployment model rooted in complex adaptive systems theory. This model acknowledges the interconnectedness of the SDGs and the ethical dilemmas that arise when firms attempt to balance performance with sustainability. The research emphasized the need for holistic, cross-functional strategies that move beyond siloed approaches. With recent global disruptions exposing the fragility of current systems, firms must adopt integrated frameworks that incorporate ethical AI and sustainability principles into core business operations.

In summary, the collective body of research affirms that AI holds immense potential to advance the SDGs by improving operational efficiency, enhancing decision-making, enabling data-driven innovation, and supporting inclusive economic growth. However, its benefits are not automatic. To ensure AI contributes equitably to sustainable development, strategic alignment, regulatory oversight, stakeholder engagement, and ethical frameworks are essential. The studies reviewed consistently advocate for greater interdisciplinary collaboration, empirical research, and global cooperation to bridge the gaps between technological advancement and sustainable, inclusive development. AI is not a panacea, but with thoughtful design, responsible governance,

and visionary leadership, it can be a powerful force in building a more just and sustainable future.

9. Integration of smart technologies with sustainability and marketing

As environmental sustainability becomes central to business strategy and consumer behavior, the integration of AI into green marketing is emerging as a powerful approach to align profitability with ecological responsibility. Across sectors and regions, AI is revolutionizing marketing by optimizing resource use, improving efficiency, and enabling more personalized and sustainable consumer engagement. Saadi and Azdimousa (2023) explored the convergence of green marketing and AI, highlighting how advanced technologies can enhance sustainability efforts through targeted, efficient, and transparent marketing practices. AI's predictive capabilities and data analysis can streamline resource usage, reduce waste, and support eco-friendly branding through tools like carbon footprint tracking and supply chain transparency. However, the environmental costs of AI infrastructure, algorithmic bias, and data privacy remain significant concerns. The authors advocated for AI adoption in green marketing that emphasizes ethical transparency, sustainability reporting, and consumer trust.

Baruno and Indrasari (2025) presented a comprehensive framework for integrating AI tools, such as machine learning and predictive analytics, into global green marketing strategies. These technologies not only reduce environmental impact by optimizing supply chains and minimizing resource wastage but also personalize eco-marketing to boost customer engagement. Nonetheless, the study identified key obstacles, including high implementation costs for SMEs, ethical challenges related to greenwashing, and regional disparities in AI infrastructure. The authors stressed the importance of global policy coordination and ethical governance to ensure equitable and effective AI adoption in marketing. A broader digital transformation is underway in marketing, as shown by Kumar et al. (2025), who conducted a large-scale bibliometric analysis of 2,061 publications to trace how AI, IoT, blockchain, and digital platforms are shaping green marketing. Their findings categorized these transformations into thematic clusters such as sustainable consumption, consumer behavior, and green supply chains. Businesses are advised to leverage these technologies not only for operational improvements but also to enhance storytelling, supply chain transparency, and influencer engagement. Still, challenges such as greenwashing, consumer skepticism, and the need for stronger regulation persist. The study proposed a Theory–Context–Methodology (TCM)

framework to guide future research in digital sustainability marketing and underscored the need for standards and ethical oversight.

The operational and environmental implications of AI in business sustainability are further explored by Balcıoğlu et al. (2024). Analyzing sustainability reports from Nasdaq-listed firms, the study revealed how AI enhances operational efficiency, energy optimization, and social responsibility. Companies are using AI for predictive maintenance, smart grids, waste reduction, and inclusive hiring practices. However, smaller firms face access barriers to such innovations. The research called for broader, mixed-method investigations to assess AI's role in driving sustainable business outcomes beyond large U.S. corporations. Yin et al. (2023) shifted the focus to the global renewable energy transition, showing that AI software development plays a pivotal role in promoting clean energy adoption. Through improved environmental monitoring and cost-effective tracking of emissions, AI supports stronger renewable energy policies. The study emphasized the need for robust governmental support and R&D funding to amplify AI's positive environmental impact, particularly in developing countries where institutional capacity may limit outcomes.

In sector-specific studies, the real estate and retail industries provide insightful case examples. Nuseir et al. (2025) examined how AI tools, such as deep learning and big data analytics, enhance marketing strategies in the UAE real estate sector. AI improves customer targeting, property valuation, and engagement through virtual tours and chatbots, while also supporting sustainable practices like green building compliance. The study emphasized the moderating role of environmental factors and advocates for transparent, ethical AI integration. Sohaib et al. (2025) extended this analysis by investigating the influence of AI-enabled green marketing orientations, strategic, tactical, and internal, on consumer trust and green purchase intention in the UAE. Their mixed-method study confirms that AI-driven personalization and sustainability messaging foster higher trust and satisfaction, which are critical to environmentally responsible consumer behavior. The findings reinforce the importance of signaling theory, where clear sustainability cues increase confidence in green products.

Taken together, these studies demonstrated that AI has relevant potential in green marketing, offering tools to align marketing practices with environmental values and consumer expectations. AI-driven personalization, supply chain transparency, and data analytics can all support businesses in developing more credible and impactful sustainability strategies. However, the benefits are tempered by challenges, including unequal access to AI, ethical risks,

greenwashing, and the environmental costs of digital infrastructure. To ensure that AI serves as a driver of sustainability rather than a contributor to environmental harm, organizations must adopt responsible, transparent practices and collaborate with policymakers to establish regulatory safeguards. Businesses should invest in ethical AI tools that prioritize privacy, fairness, and inclusivity, while researchers should continue to explore firm-level impacts, cross-cultural differences, and the evolution of consumer trust in green AI applications. In conclusion, AI and green marketing can form a powerful alliance to foster sustainable business models and consumer behaviors, provided their integration is governed by ethical, transparent, and inclusive principles.

10. AI Tools supporting smart and green marketing

The integration of AI into digital marketing has redefined customer engagement, brand strategy, and sustainability efforts across industries. AI-powered tools such as chatbots, deep learning algorithms, neural networks, and Generative AI (GenAI) are enabling businesses to personalize communication, optimize operations, and promote green development, all while enhancing economic performance and customer satisfaction. Koswara (2025) investigated the strategic use of AI-powered chatbots across sectors like e-commerce, food delivery, finance, and entertainment. Through qualitative content analysis and grounded in the Technology Acceptance Model (TAM) and customer relationship management theory, the study identified personalization, structured dialogue, promotional integration, and feedback mechanisms as key design features. Successful chatbot examples, like HelloFresh's "Freddy FreshBot" and Spotify's recommender bot, demonstrate how context-aware messaging and hybrid input interfaces (buttons and open text) drive customer loyalty and conversions. These chatbots served not only as service agents but also as data-rich marketing tools. However, limitations such as poor conversational flow or lack of escalation options can hinder effectiveness, suggesting a need for seamless human-AI handoffs.

Extending this perspective, Kumar et al. (2024) explored how AI platforms like ChatGPT are transforming brand marketing. Case studies such as TravelXcite reveal how AI enables personalized experiences, real-time customer service, and marketing innovation. The research highlighted the importance of setting ethical boundaries, ensuring transparency, and aligning AI use with clear marketing goals. Human-AI collaboration is emphasized as a catalyst for creativity, allowing marketers to explore unconventional strategies while maintaining consumer

trust. In the context of smart infrastructure, Alijoyo (2024) introduced a deep learning framework that integrates Convolutional Neural Networks (CNNs) with IoT for energy management in smart buildings. Achieving high accuracy and outperforming traditional machine learning methods, the system enables real-time monitoring and anomaly detection to optimize energy usage. This AI-IoT synergy supports sustainable energy practices, offering a scalable solution for reducing consumption and operational costs in urban environments. From a sustainability standpoint, Hu et al. (2025) proposed a CNN-based prediction model for AI-driven digital marketing and demonstrated how AI can simultaneously enhance profitability and promote green development. The model, which combines CNNs with linear regression, boosts enterprise sales performance by 27.8% while supporting environmentally responsible practices. Key benefits included precise consumer targeting, real-time sentiment analysis, and increased efficiency. The study also outlined essential steps for green transformation, including upgrading equipment for environmental compliance and fostering a sustainability-oriented corporate culture.

Recent research highlighted the transformative impact of AI, particularly GenAI, on marketing communication and customer engagement. Rodríguez Guzmán (2024) emphasized AI's role in revolutionizing marketing strategies by enabling personalized messaging, campaign automation, and sophisticated data analysis. Through expert interviews and surveys, this study identified AI technologies, such as machine learning, natural language processing, and predictive analytics, as key drivers that enhance customer segmentation, real-time decision-making, and content customization, while also automating routine tasks. However, challenges including technical integration, costs, ethical concerns, and data privacy necessitate robust governance and ongoing training. Best practices recommended include aligning AI with business goals, ensuring transparency, and continuous system refinement. Further, Grewal et al. (2024) proposed a four-quadrant framework that guides marketers in selecting appropriate GenAI applications based on the nature of inputs (structured vs. unstructured) and levels of human augmentation. This framework aided in balancing creativity, efficiency, and personalization while clarifying when human involvement remains critical. These studies collectively highlight AI's transformative impact on marketing, emphasizing ethical use, strategic integration, and human-AI collaboration. They reveal how AI enhances customer engagement, boosts efficiency, and promotes sustainability, positioning businesses for innovation, competitive advantage, and long-term growth in the evolving digital landscape.

11. Challenges of green marketing in the age of ai and sustainability

Green marketing faces multifaceted challenges as businesses strive to align profitability with environmental responsibility in an increasingly eco-conscious and digitally driven marketplace. Key obstacles include regulatory compliance, consumer skepticism, and the growing threat of greenwashing, which can undermine trust and brand credibility. In emerging markets, factors such as price sensitivity, inadequate infrastructure, and limited consumer awareness further hinder green marketing adoption. The integration of advanced technologies like AI introduces both opportunities and ethical dilemmas, raising concerns over data privacy, algorithmic bias, environmental costs, and the erosion of consumer trust. High implementation costs and technical complexity especially affect small and medium-sized enterprises (SMEs), exacerbating inequalities in sustainable innovation. Additionally, a lack of standardized frameworks, inconsistent sustainability metrics, and insufficient regulatory oversight complicate responsible AI adoption in marketing. The evolving consumer landscape demands authentic, personalized communication that balances ecological values with business performance. Meeting these expectations requires strategic alignment across departments, investment in ethical digital tools, robust stakeholder engagement, and adaptability to rapidly shifting technological, cultural, and regulatory environments. To succeed, firms must embed transparency, fairness, and long-term sustainability into their core marketing strategies, transforming green marketing from a peripheral initiative into a central driver of innovation, trust, and competitive advantage.

12. Future research directions for AI integration with green marketing

The future of green marketing is rooted in the ethical integration of advanced technologies with sustainability-driven strategies. As AI, big data, and the IoT continue to evolve, marketers will gain powerful tools to deliver personalized, transparent, and verifiable environmental messaging at scale. AI-enabled applications, such as chatbots, recommender systems, and predictive analytics, will support real-time engagement, optimize resource use, and enhance eco-friendly brand positioning. However, these benefits must be balanced with ethical concerns, including data privacy, algorithmic bias, and the risk of greenwashing. As consumer expectations for authenticity and accountability grow, regulatory scrutiny will intensify,

making responsible data governance essential. Businesses that embrace circular economy principles, invest in ethical AI, and tailor green campaigns to diverse cultural and regional contexts will be well-positioned to earn consumer trust and loyalty. Emerging markets offer promise through inclusive, education-focused approaches to sustainability. Moreover, integrating green marketing with broader ESG frameworks will drive resilience, innovation, and long-term profitability. Moving forward, successful green marketing will depend on transparency, stakeholder engagement, and continuous technological adaptation, transforming sustainability from a marketing tactic into a core business imperative in a rapidly evolving global landscape.

13. Conclusion and recommendations

In conclusion, green marketing has evolved from a peripheral tactic into a core strategic imperative vital for businesses pursuing sustainable growth amid growing environmental awareness. By embedding ecological values throughout the marketing mix, companies build consumer trust, foster loyalty, and enhance long-term profitability.

Consistent with recent scholarship, this review confirms that digital innovations—especially artificial intelligence (AI) and big data analytics—significantly amplify green marketing's impact. Our findings align with Verma et al. (2021) regarding the operational efficiency of AI in marketing; however, this study extends their perspective by identifying AI not just as a tool for efficiency, but as a critical enabler for closing the "intention-behavior gap" in sustainable consumption. While previous research, such as Tu et al. (2017), heavily emphasized the role of IoT in consumer education, our synthesis reveals that AI-driven personalization is now the dominant driver for real-time engagement and behavioral nudging. Furthermore, contrary to earlier techno-optimist views, this review echoes the concerns raised by Vinuesa et al. (2020), suggesting that without robust ethical governance, the digitalization of green marketing risks exacerbating consumer skepticism rather than resolving it.

The successful integration of these technologies depends on balancing automation with human-centric values. Beyond product promotion, green marketing now encompasses ethical sourcing, sustainable supply chains, and transparent reporting. As highlighted in our analysis, empirical evidence suggests that these practices contribute to environmental stewardship while reducing costs. However, these technological advances must be implemented ethically, with

transparency and responsible data governance, to preserve consumer trust and avoid potential backlash.

For marketing practitioners, the integration of AI into sustainability strategies is no longer optional but essential for competitive advantage. Managers should leverage predictive analytics to identify eco-conscious consumer segments more accurately and use chatbots/virtual assistants to educate customers about product lifecycles. However, technology must be used with transparency; brands that use AI solely for "green positioning" without tangible substantiation risk severe reputational damage.

Theoretically, this study bridges the fragmented literature between *Information Systems* (IS) and *Sustainable Marketing*. It proposes that "Digital Green Marketing" should be treated as a distinct sub-discipline, characterized by data-driven empathy and automated ethical engagement.

Despite the promising synergies identified in this review, several critical gaps warrant further investigation. A primary limitation in the current literature is the predominant focus on immediate purchase intentions rather than long-term habit formation; therefore, future research should employ longitudinal designs to assess whether AI nudges effectively cultivate permanent sustainable lifestyle changes. Furthermore, as companies increasingly leverage vast datasets to profile "green" consumers, privacy and data ethics emerge as significant concerns, necessitating a deeper exploration of the eco-conscious consumer's "privacy calculus." Finally, given that a significant portion of the reviewed literature originates from developed economies, comparative studies are essential to understand how AI-driven green marketing resonates within emerging markets characterized by varying levels of digital literacy. Ultimately, businesses that authentically align sustainability with consumer education and ethical digital transformation will secure a competitive advantage and contribute meaningfully to global sustainability goals.

REFERENCES

Al-Ababneh, H. A., Alkhudierat, N. A., Al-Shaikh, M. S., Zawaideh, F. H., Alhosban, A., & Mugableh, M. I. (2025). Artificial intelligence in marketing to promote renewable energy. In E3S Web of Conferences (Vol. 614, p. 01013). EDP Sciences. https://www.e3s-

conferences.org/articles/e3sconf/abs/2025/14/e3sconf_icaw2024_01013/e3sconf_icaw2024_01013.html

Alijoyo, F. A. (2024). AI-powered deep learning for sustainable industry 4.0 and internet of things: Enhancing energy management in smart buildings. *Alexandria Engineering Journal,* 104, 409-422. https://www.sciencedirect.com/science/article/pii/S1110016824008512

Amoako, G. K., Dzogbenuku, R. K., Doe, J., & Adjaison, G. K. (2022). Green marketing and the SDGs: emerging market perspective. Marketing Intelligence & Planning, 40(3), 310-327. https://www.emerald.com/insight/content/doi/10.1108/MIP-11-2018-0543/full/html

Arseculeratne, D., & Yazdanifard, R. (2014). How green marketing can create a sustainable competitive advantage for a business. *International business research*, 7(1), 130.

Balcıoğlu, Y. S., Çelik, A. A., & Altındağ, E. (2024). Artificial intelligence integration in Sustainable Business Practices: A text mining analysis of USA firms. Sustainability, 16(15), 6334. https://www.mdpi.com/2071-1050/16/15/6334

Bano, R., Azim, F., Mahmood, Z., Sanaullah, A., & Ali, O. (2025). The Role of Artificial Intelligence in Personalized Marketing: Enhancing Customer Experience, Predictive Targeting, and Brand Engagement. *The Critical Review of Social Sciences Studies, 3(2)*, 50-65. http://thecrsss.com/index.php/Journal/article/view/430

Baruno, A. D., & Indrasari, M. (2025). Leveraging AI To Enhance Green Marketing Strategies. *Jurnal Ekonomi, Manajemen, Akuntansi dan Keuangan,* 6(1). https://penerbitadm.pubmedia.id/index.php/jurnalemak/article/view/2206

Bhardwaj, S., Sharma, N., Goel, M., Sharma, K., & Verma, V. (2024). Enhancing customer targeting in e-

commerce and digital marketing through AI-driven personalization strategies. Advances in Digital Marketing in the Era of Artificial Intelligence, 41-60. https://www.taylorfrancis.com/chapters/edit/10.1201/9781003450443-4/enhancing-customer-targeting-commerce-digital-marketing-ai-driven-personalization-strategies-suyash-bhardwaj-nirmesh-sharma-mausmi-goel-vandana-kirti-sharma-vineeta-verma

Bobojonova, M. (2025). Marketing in the green economy: strategies, trends, and impacts. *International Journal of Artificial Intelligence,* 1(4), 1401-1404. https://inlibrary.uz/index.php/ijai/article/view/106651

Burns, N., & Grove, S. K. (2009). The practice of nursing research: Appraisal, synthesis, and generation of evidence. (6th ed., pp. 90-119, 598-610). USA: Saunders.

Chamorro, A., Rubio, S., & Miranda, F. J. (2009). Characteristics of research on green marketing. *Business strategy and the environment, 18(4),* 223-239. https://onlinelibrary.wiley.com/doi/abs/10.1002/bse.571

Cui, C., Shaari, N., Zainal Abidin, S., & Mohd Ali, N. A. (2025). Sustainable style: unraveling the trends and future of green marketing in the textile and apparel industry. *Sustainability, 17(1)*, 292. https://www.mdpi.com/2071-

1050/17/1/292?utm_campaign=releaseissue_sustainabilityutm_medium=emailutm_source=releaseissueutm_term=titlelink369

Desta, E., & Amantie, C. (2024). The role of artificial intelligence on market performance: Evidence from scientific review. *Journal of Economics and Behavioral Studies, 16(1),* 82-93. https://ideas.repec.org/a/rnd/arjebs/v16y2024i1p82-93.html

Dirican, C. (2015). The effects of technological development and artificial intelligence studies on marketing. *Journal of Management Marketing and Logistics, 2(3).* https://dergipark.org.tr/en/pub/jmml/article/360789

Du, S., & Xie, C. (2021). Paradoxes of artificial intelligence in consumer markets: Ethical challenges and opportunities. *Journal of Business Research, 129,* 961-974. https://www.sciencedirect.com/science/article/pii/S0148296320305312

Duvnjak, K., Gregorić, M., & Gorše, M. (2020). Sustainable development–an artificial intelligence approach. *Management Research and Practice,* 12(4), 18-28. https://www.ceeol.com/search/article-detail?id=912065

Esmaelnezhad, D., Lagzi, M. D., Antucheviciene, J., Hashemi, S. S., & Khorshidi, S. (2023). Evaluation of green marketing strategies by considering sustainability criteria. *Sustainability, 15(10)*, 7874. https://www.mdpi.com/2071-1050/15/10/7874

Espina-Romero, L., Noroño Sánchez, J. G., Gutiérrez Hurtado, H., Dworaczek Conde, H., Solier Castro, Y., Cervera Cajo, L. E., & Rio Corredoira, J. (2023). Which industrial sectors are affected by artificial intelligence? A bibliometric analysis of trends and Perspectives. *Sustainability, 15(16),* 12176. https://www.mdpi.com/2071-1050/15/16/12176

Goralski, M. A., & Tan, T. K. (2020). Artificial intelligence and sustainable development. *The International Journal of Management Education, 18(1),* 100330. https://www.sciencedirect.com/science/article/pii/S1472811719300138

Grewal, D., Guha, A., Beccacece Satornino, C., & Becker, M. (2025). The future of marketing and marketing education. *Journal of Marketing Education, 47(1),* 61-77. https://journals.sagepub.com/doi/abs/10.1177/02734753241269838

Grewal, D., Guha, A., Satornino, C. B., & Schweiger, E. B. (2021). Artificial intelligence: The light and the darkness. *Journal of Business Research, 136*, 229-236. https://www.sciencedirect.com/science/article/pii/S0148296321005294

Grewal, D., Satornino, C. B., Davenport, T., & Guha, A. (2024). How generative AI Is shaping the future of marketing. *Journal of the Academy of Marketing Science,* 1-21. https://link.springer.com/article/10.1007/s11747-024-01064-3

Gündüzyeli, B. (2024). Artificial intelligence in digital marketing within the framework of sustainable management. *Sustainability* 16, 10511. https://doi.org/10.3390/su162310511.

Haleem, A., Javaid, M., Qadri, M. A., Singh, R. P., & Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. *International Journal of Intelligent Networks, 3,* 119-132. https://www.sciencedirect.com/science/article/pii/S2666603022000136

Hassan, N., Abdelraouf, M., & El-Shihy, D. (2025). The moderating role of personalized recommendations in the trust–satisfaction–loyalty relationship: an empirical study of AI-driven e-commerce. *Future Business Journal, 11(1),* 66. https://link.springer.com/article/10.1186/s43093-025-00476-z

Hu, Q., Xu, Q., Wu, J., & Zhang, L. (2025). Neural network prediction model of digital marketing under the green development mode of enterprises. *Discover Computing, 28(1),* 1-12. https://link.springer.com/article/10.1007/s10791-025-09568-4

Huang, M. H., & Rust, R. T. (2021). A strategic framework for artificial intelligence in marketing. *Journal of the academy of marketing science,* 49, 30-50. https://link.springer.com/article/10.1007/s11747-020-00749-9

Jankovic, S. D., & Curovic, D. M. (2023). Strategic integration of artificial intelligence for sustainable businesses: implications for data management and human user engagement in the digital era. Sustainability, 15(21), 15208. https://www.mdpi.com/2071-1050/15/21/15208.

Jyoti, J. (2013). An Introduction To Green Marketing-Emerging Dimensions, Strategies, Opportunities, Challenges and Trends: A Review. Journal of Management and Science, 3(3), 419-429. https://jmseleyon.com/index.php/jms/article/view/260

Kartajaya, H., Kotler, P., & Hooi, D. H. (2019). Marketing 4.0: moving from traditional to digital. World Scientific Book Chapters, 99-123. https://ideas.repec.org/h/wsi/wschap/9789813275478_0004.html

Khajeh, N. S., & Nouhi, N. (2023). The Environmental Impacts of AI and Digital Technologies. https://www.sid.ir/paper/1403735/en

Koswara, A. (2025). Exploring how ai-powered chatbots enhance data-driven marketing communication and customer engagement. Southsight: *Journal of Media and Society Inquiry, 1(1),* 25-37. https://ejournal2.undip.ac.id/index.php/southsight/article/view/26091

Kulkov, I., Kulkova, J., Rohrbeck, R., Menvielle, L., Kaartemo, V., & Makkonen, H. (2024). Artificial intelligence-driven sustainable development: Examining organizational, technical, and processing approaches to achieving global goals. *Sustainable Development, 32(3),* 2253-2267. https://onlinelibrary.wiley.com/doi/abs/10.1002/sd.2773

Kumar, A., Bapat, G., Kumar, A., Hota, S. L., Abishek, G. D., & Vaz, S. (2024). Unlocking brand excellence: harnessing AI tools for enhanced customer engagement and innovation. *Engineering Proceedings, 59(1),* 204. https://www.mdpi.com/2673-4591/59/1/204

Kumar, S. D., Soundarapandiyan, K., & Meera, S. (2024, June). Influence of technological innovation in marketing on consumer behaviour. In International Conference on Digital Transformation in Business: Navigating the New Frontiers Beyond Boundaries (DTBNNF 2024) (pp. 109-122). Atlantis Press. https://www.atlantis-press.com/proceedings/dtbnnf-24/126000472

Kumar, S., Sharma, C., Mishra, M. K., Sharma, S., & Bhardwaj, V. (2025). Smart, sustainable, and green: the digital transformation of green-marketing. *Discover Sustainability, 6(1),* 1-25. https://link.springer.com/article/10.1007/s43621-025-01242-5

Kshetri, N., Dwivedi, Y. K., Davenport, T. H., & Panteli, N. (2024). Generative artificial intelligence in marketing: Applications, opportunities, challenges, and research agenda. *International Journal of Information Management,* 75, 102732. https://doi.org/10.1016/j.ijinfomgt.2023.102716

Leal Filho, W., Yang, P., Eustachio, J.H.P.P., Azul, A.M., Gellers, J.C., Gielczyk, A., Dinis, M.A.P., and Kozlova, V., 2023. Deploying digitalisation and artificial intelligence in sustainable development research. *Environment, Development and Sustainability, 25(6),*4957-4988. https://link.springer.com/article/10.1007/s10668-022-02252-3

Lee, Y. S., Kim, T., Choi, S., & Kim, W. (2022). When does AI pay off? AI-adoption intensity, complementary investments, and R&D strategy. *Technovation, 118*, 102590. https://www.sciencedirect.com/science/article/pii/S0166497222001377

McDaniel, S. W., & Rylander, D. H. (1993). Strategic green marketing. *Journal of consumer marketing, 10(3),* 4-10. https://www.emerald.com/insight/content/doi/10.1108/07363769310041929/full/html

Mei, Y., Geng, L., Cao, X., & Xie, Y. (2025). Artificial intelligence in green marketing: A systematic literature review. *Sustainability, 17(22*), 10382. https://doi.org/10.3390/su172210382

Mishra, P., & Sharma, P. (2014). Green marketing: Challenges and opportunities for business. *BVIMR Management Edge,* 7(1). https://www.academia.edu/download/39210570/document.pdf

Nasir, O., Javed, R. T., Gupta, S., Vinuesa, R., & Qadir, J. (2023). Artificial intelligence and sustainable development goals nexus via four vantage points. *Technology in Society, 72,* 102171. https://www.sciencedirect.com/science/article/pii/S0160791X22003128

Nuseir, M. T., Aljumah, A., & Refae, G. A. E. (2025). Revolution of the marketing mix idea using AI tech to forecast strategic marketing decision management with moderating effect of environmental parameters in UAE real estate industry. *International Journal of Economics and Business Research, 29(12),* 1-22. https://www.inderscienceonline.com/doi/abs/10.1504/IJEBR.2025.146109

Phuangsuwan, P., Siripipatthanakul, S., Chaiprakarn, S., Rakpathum, W., Muthmainnha, Pariwongkhuntorn, N., & Wattanakul, P. (2024, June). Sustainable Development Adopting Artificial Intelligence (AI) in Marketing and Consumer Behaviour Analysis. In International Conference on Data Analytics & Management (pp. 569-587). Singapore: Springer Nature Singapore. https://link.springer.com/chapter/10.1007/978-981-96-3372-2_39

Polonsky, M. J. (1994). An introduction to green marketing. *Electronic Green Journal*, 1(2).

Polonsky, M. J. (2011). Transformative green marketing: Impediments and opportunities. *Journal of Business Research, 64(12),* 1311-1319. https://www.sciencedirect.com/science/article/pii/S0148296311000300.

Rathore, B. (2018). Navigating the Green marketing landscape: best practices and future trends. *Nature, 17*, 18.

Regona, M., Yigitcanlar, T., Hon, C., & Teo, M. (2024). Artificial intelligence and sustainable development goals: Systematic literature review of the construction industry. *Sustainable*

Cities and Society, 105499. https://www.sciencedirect.com/science/article/pii/S2210670724003251

Rodríguez Guzmán, M. M. (2024). Using generative AI tools to improve marketing communication: opportunities, challenges and best practices. https://riunet.upv.es/handle/10251/207793

Roy, M. (2025). Implementation of Generative AI: Measuring Marketing Activities for Enhanced Customer Experience. In Social, Ethical and Legal Aspects of Generative AI (pp. 29-45). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-031-87252-5_3

Saadi, S., & Azdimousa, H. (2023, October). Artificial Intelligence and Green Marketing: What Link?. In International Conference on Advanced Intelligent Systems for Sustainable Development (pp. 104-113). Cham: Springer Nature Switzerland. https://link.springer.com/chapter/10.1007/978-3-031-54288-6_10

Saini, B. (2014). Green marketing in India: emerging opportunities and challenges. IOSR Journal of Business and Management, 15(6), 67-73. https://www.academia.edu/download/66426640/487x-1566773.pdf

Salhab, H., Zoubi, M., Khrais, L. T., Estaitia, H., Harb, L., Al Huniti, A., & Morshed, A. (2025). AI-Driven Sustainable Marketing in Gulf Cooperation Council Retail: Advancing SDGs Through Smart Channels. Administrative Sciences, 15(1), 20. https://www.mdpi.com/2076-3387/15/1/20

Satornino, C. B., Du, S., & Grewal, D. (2024). Using artificial intelligence to advance sustainable development in industrial markets: A complex adaptive systems perspective. Industrial Marketing Management, 116, 145-157. https://www.sciencedirect.com/science/article/pii/S0019850123002250

Saxena, R. P., & Khandelwal, P. K. (2009). Green marketing: a challenge or an opportunity in the global environment. https://ro.uow.edu.au/articles/journal_contribution/Green_marketing_a_challenge_or_an_opportunity_in_the_global_environment/27698493

Sohaib, O., Alshemeili, A., & Bhatti, T. (2025). Exploring AI-enabled green marketing and green intention: An integrated PLS-SEM and NCA approach. *Cleaner and Responsible Consumption*. https://opus.lib.uts.edu.au/handle/10453/187213

Su, S., & Li, Y. (2024). Exploring the impact of the green marketing mix on environmental attitudes and purchase intentions: moderating role of environmental knowledge in China's emerging markets. *Sustainability, 16(24),* 10934. https://doi.org/10.3390/su162410934

Sumarsono, H., Narmaditya, B. S., Rahmawati, F., Prayitno, P. H., & Sahid, S. (2025). Green marketing for sustainability business: A bibliometric analysis. Multidisciplinary Reviews, 8(3), 2025078-2025078. https://www.malque.pub/ojs/index.php/mr/article/view/4113

Tu, J. C., Chen, Y. Y., & Chen, S. C. (2017). The study of consumer green education via the internet of things with green marketing. Eurasia Journal of Mathematics, Science and

Technology Education, 13(9), 6133-6145. https://www.ejmste.com/article/the-study-of-consumer-green-education-via-the-internet-of-things-with-green-marketing-5016

Verma, S., Sharma, R., Deb, S., & Maitra, D. (2021). Artificial intelligence in marketing: Systematic review and future research direction. International Journal of Information Management Data Insights, 1(1), 100002. https://www.sciencedirect.com/science/article/pii/S2667096820300021

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S.D., Tegmark, M. and Fuso Nerini, F., 2020. The role of artificial intelligence in achieving the Sustainable Development Goals. Nature communications, 11(1), p.233. https://www.nature.com/articles/s41467-019-14108-y

Vlačić, Božidar & Corbo, Leonardo & Costa e Silva, Susana & Dabić, Marina, (2021). The evolving role of artificial intelligence in marketing: A review and research agenda, *Journal of Business Research, Elsevier, 128*, 187-203.

Xiao, D., & Su, J. (2022). Role of technological innovation in achieving social and environmental sustainability: mediating roles of organizational innovation and digital entrepreneurship. Frontiers in Public Health, 10, 850172. https://www.frontiersin.org/articles/10.3389/fpubh.2022.850172/full

Yin, H. T., Wen, J., & Chang, C. P. (2023). Going green with artificial intelligence: The path of technological change towards the renewable energy transition. Oeconomia Copernicana, 14(4), 1059-1095. https://www.ceeol.com/search/article-detail?id=1238130

Zhou, C., & Jiang, B. (2025). How do consumers react to AI-generated green marketing content? A hybrid analysis using PLS-SEM and text mining. *Journal of Retailing and Consumer Services*, *87*, 104431. https://doi.org/10.1016/j.jretconser.2025.104431