ARTIFICIAL INTELLIGENCE IN GREEN MARKETING: A COMPREHENSIVE ANALYSIS OF SUSTAINABLE CONSUMER ENGAGEMENT

Prof. (Dr.) Mahesh Sharma
Professor and Director, Delhi School of Professional Studies & Research (GGSIPU), Delhi (India)

Dr. Mukta Katyal
Academic Coordinator, School of Professional Studies & Research (GGSIPU), Delhi (India)

Tanya Singhal
Student, BBA 3 rd Year, Delhi School of Professional Studies & Research (GGSIPU), Delhi (India)

Abstract
The intersection of artificial intelligence and green marketing represents a transformative paradigm in sustainable business practices. This paper provides a comprehensive examination of how AI technologies are revolutionizing green marketing strategies, enabling organizations to optimize environmental communications, personalize sustainable product recommendations, and enhance consumer engagement with eco-friendly initiatives. Through systematic analysis of AI applications including machine learning algorithms, natural language processing, predictive analytics, and computer vision, this research identifies key mechanisms through which AI enhances the effectiveness of green marketing campaigns. The study explores AI-driven consumer segmentation, automated content creation for sustainability messaging, real-time environmental impact tracking, and intelligent supply chain optimization. Furthermore, it addresses critical challenges including algorithmic bias in sustainability claims, data privacy concerns,greenwashing detection, and the carbon footprint of AI systems themselves. The findings indicate that AI significantly improves targeting accuracy, message personalization, and campaign effectiveness while simultaneously raising important ethical considerations. This paper contributes to the growing body of knowledge on sustainable marketing practices by providing insights into the strategic implementation of AI technologies for environmental communication, offering practical recommendations for marketers, policymakers, and technology developers seeking to leverage AI for authentic sustainable brand development.

Keywords: Artificial Intelligence, Green Marketing, Sustainable Marketing, Machine Learning, Consumer Behavior, Environmental Communication, Predictive Analytics, Greenwashing Detection

I. INTRODUCTION

The convergence of artificial intelligence and green marketing has emerged as a critical frontier in contemporary business strategy, driven by escalating environmental concerns, evolving consumer expectations, and rapid technological advancement. Green marketing, defined as the promotion of products and services based on environmental benefits, has transitioned from a niche strategy to a mainstream business imperative as consumers increasingly prioritize sustainability in purchasing decisions. Recent studies indicate that over 73% of global consumers are willing to change their consumption habits to reduce environmental impact, while 81% expect companies to be environmentally conscious in their operations and communications.

Artificial intelligence, encompassing machine learning, natural language processing, computer vision, and predictive analytics, offers unprecedented capabilities for enhancing green marketing effectiveness. AI technologies enable sophisticated consumer behavior analysis, personalized sustainability messaging, automated environmental impact assessment, and real-time campaign optimization. These capabilities address fundamental challenges in green marketing, including consumer skepticism regarding environmental claims, the complexity of communicating technical sustainability data, difficulty in targeting genuinely eco-conscious consumers, and the resource intensity of traditional marketing approaches.

The integration of AI into green marketing practices represents more than technological enhancement; it signifies a fundamental reimagining of how organizations communicate environmental value propositions and engage consumers in sustainability initiatives. AI-powered systems can analyze vast datasets to identify authentic environmental benefits, detect and prevent greenwashing, optimize resource allocation in marketing campaigns, and create highly personalized experiences that resonate with diverse consumer segments. However, this integration also introduces complex challenges related to algorithmic transparency, data privacy, the environmental cost of computational infrastructure, and the potential for AI systems to perpetuate or amplify misleading environmental claims.

This paper systematically examines the role of artificial intelligence in green marketing, analyzing current applications, evaluating effectiveness, identifying emerging trends, and proposing frameworks for responsible implementation. The research addresses three primary objectives: first, to comprehensively map the landscape of AI applications in green marketing across various industries and consumer touchpoints; second, to critically assess the effectiveness of AI-driven approaches in enhancing consumer engagement with sustainable products and practices; and third, to identify ethical considerations and best practices for deploying AI in environmental communication.

II. LITERATURE REVIEW

A. Evolution of Green Marketing

Green marketing has evolved through distinct phases since its emergence in the late 1980s. The ecological marketing phase focused primarily on addressing environmental problems through product modifications and waste reduction. The environmental marketing phase emphasized compliance with environmental regulations and communicating corporate environmental responsibility. The sustainable marketing phase integrated economic, environmental, and social considerations into comprehensive business strategies. Contemporary green marketing represents a holistic approach encompassing product design, supply chain management, communications, and stakeholder engagement. Research has identified several factors influencing green marketing effectiveness, including consumer environmental concern, perceived consumer effectiveness, trust in environmental claims, and the credibility of information sources. Studies demonstrate that effective green marketing requires authenticity, transparency, substantiation of claims, and alignment between corporate communications and actual environmental performance. However, traditional green marketing approaches face limitations in personalization capabilities, real-time responsiveness, scalability, and the ability to process complex environmental data for consumer-friendly communication.

B. Artificial Intelligence Technologies

Artificial intelligence encompasses various technologies with distinct capabilities relevant to marketing applications. Machine learning algorithms enable pattern recognition in consumer behavior, predictive modeling of purchase intentions, and automated optimization of marketing campaigns. Natural language processing facilitates sentiment analysis of consumer attitudes toward sustainability, automated generation of environmental communications, and conversational interfaces for sustainability education. Computer vision enables product recognition for recycling applications, visual content analysis for brand consistency, and automated monitoring of environmental conditions. Predictive analytics leverages historical data to forecast trends, identify high-value consumer segments, and optimize resource allocation.

Recent advances in deep learning, particularly transformer architectures and generative models, have expanded AI capabilities in content creation, personalization, and complex decision-making. These technologies enable sophisticated understanding of context, generation of human-quality text and images, and multi-modal integration of diverse data sources. The application of these advanced AI capabilities to marketing has demonstrated significant improvements in campaign performance, consumer engagement, and return on marketing investment across various industries.

C. Intersection of AI and Sustainability

The intersection of AI and sustainability extends beyond marketing to encompass environmental monitoring, climate modeling, renewable energy optimization, and sustainable agriculture. However, this intersection is paradoxical: while AI offers powerful tools for addressing environmental challenges, AI systems themselves consume substantial energy and resources. Data centers supporting AI operations account for approximately 1% of global electricity

consumption, with training large language models generating carbon emissions equivalent to multiple transatlantic flights. This inherent tension necessitates careful consideration of the net environmental impact of AI applications in green marketing.

Emerging research explores AI for sustainability across multiple dimensions: AI for sustainable marketing practices, AI for environmental impact assessment, AI for circular economy enablement, and sustainable AI development. This multi-dimensional perspective recognizes that responsible integration of AI in green marketing requires not only leveraging AI capabilities for environmental communication but also minimizing the environmental footprint of AI systems themselves and ensuring ethical implementation aligned with sustainability principles.

III. AI APPLICATIONS IN GREEN MARKETING

A. Consumer Segmentation and Targeting

AI-powered consumer segmentation represents a fundamental application in green marketing, enabling identification of distinct consumer groups based on environmental attitudes, behaviors, and preferences. Machine learning algorithms analyze diverse data sources including purchase history, social media activity, demographic information, and psychographic characteristics to create detailed consumer profiles. Clustering algorithms such as k-means, hierarchical clustering, and density-based methods identify natural groupings within consumer populations, revealing segments such as committed environmentalists, convenience-oriented buyers, price-sensitive consumers, and sustainability skeptics. Advanced segmentation approaches employ ensemble methods combining multiple algorithms to improve accuracy and robustness. Neural network architectures enable deep segmentation that captures complex, non-linear relationships between consumer characteristics and environmental behaviors.

These sophisticated models identify micro-segments with specific environmental concerns, preferred communication channels, and optimal message framing. For example, AI analysis might distinguish between consumers motivated primarily by health benefits of organic products versus those driven by biodiversity conservation concerns, enabling precisely tailored marketing approaches for each group. Predictive segmentation extends beyond descriptive categorization to forecast future behavior, identifying consumers likely to transition toward more sustainable consumption patterns. These predictive models enable proactive marketing strategies that engage consumers at optimal moments in their sustainability journey. Real-time segmentation adjusts consumer classifications dynamically based on recent behaviors, ensuring marketing messages remain relevant as consumer attitudes and circumstances evolve.

B. Personalized Content Creation and Delivery

Natural language processing and generative AI technologies enable automated creation of personalized sustainability content at scale. These systems generate product descriptions emphasizing environmental attributes most relevant to individual consumers, create customized educational content explaining environmental impacts in accessible language, and develop

tailored recommendations for sustainable alternatives to current purchases. Advanced language models understand context, maintain brand voice consistency, and adapt complexity levels to match consumer knowledge and engagement preferences.

AI-driven content personalization extends beyond text to encompass visual content, email campaigns, website experiences, and mobile applications. Computer vision systems analyze product images to automatically identify and highlight environmental features. Recommendation engines suggest sustainable products based on individual preferences, past purchases, and browsing behavior. Dynamic pricing algorithms can offer incentives for choosing environmentally preferable options, while A/B testing systems continuously optimize message effectiveness across different consumer segments. Conversational AI interfaces, including chatbots and virtual assistants, provide interactive sustainability guidance, answering consumer questions about environmental impacts, explaining certification standards, and offering personalized tips for reducing environmental footprints. These systems operate 24/7, providing consistent information while learning from interactions to improve response quality over time. Integration with e-commerce platforms enables seamless transition from information-seeking to purchasing decisions, reducing friction in the sustainable consumption journey.

C. Environmental Impact Tracking and Communication

AI systems enable real-time tracking and communication of environmental impacts across product lifecycles. Computer vision and sensor integration monitor manufacturing processes, supply chain operations, and product usage to generate accurate environmental footprint data. Machine learning models synthesize this data to calculate comprehensive environmental metrics including carbon emissions, water consumption, waste generation, and ecosystem impacts. These calculations account for complex interdependencies and lifecycle stages that would be impractical to assess manually. Natural language generation transforms technical environmental data into consumer-friendly communications. These systems explain lifecycle assessment results in accessible terms, compare environmental performance across alternatives, and contextualize impacts using relatable benchmarks. For example, AI might translate carbon emission data into equivalent miles driven or trees needed for offsetting, making abstract environmental metrics tangible and meaningful for consumers. Interactive visualizations generated by AI systems enable consumers to explore environmental data at varying levels of detail, catering to both casual interest and deep investigation. Blockchain integration with AI enables transparent, verifiable environmental claims. Smart contracts automatically record environmental data at each supply chain stage, while AI systems verify data accuracy and detect anomalies suggesting misrepresentation. This combination addresses critical trust deficits in green marketing by providing independently verifiable evidence of environmental performance rather than relying solely on corporate self-reporting.

D. Greenwashing Detection and Prevention

AI technologies serve dual roles in greenwashing, both as potential amplifiers and as detection mechanisms. Natural language processing systems analyze marketing communications to

identify patterns associated with greenwashing, including vague or unsubstantiated claims, misleading imagery, hidden trade-offs, irrelevant claims, and false labels. Machine learning classifiers trained on verified examples of greenwashing can flag potentially problematic content for review before publication, helping organizations avoid inadvertent misrepresentation. Computer vision systems analyze visual marketing materials to detect disconnects between imagery and actual environmental performance. These systems identify nature imagery that may create false environmental associations, assess whether product packaging accurately represents contents, and verify consistency between visual branding and documented sustainability practices. Sentiment analysis monitors consumer responses to environmental claims, identifying skepticism or backlash that may indicate greenwashing perceptions.

Third-party AI systems operated by regulatory bodies, consumer advocacy organizations, and independent researchers enable systematic greenwashing surveillance across industries. These systems aggregate environmental claims, cross-reference against verified performance data, and identify patterns of systematic misrepresentation. Public access to AI-powered greenwashing detection tools empowers consumers to independently verify claims, creating market accountability beyond regulatory enforcement.

IV. CASE STUDIES AND INDUSTRY APPLICATIONS

A. Retail and E-Commerce

Major e-commerce platforms have implemented AI-driven sustainability features that demonstrate significant impact on consumer behavior. Product recommendation algorithms now incorporate environmental criteria alongside traditional factors like price and reviews. These systems analyze product environmental certifications, packaging characteristics, transportation distances, and manufacturer sustainability practices to identify and promote eco-friendly alternatives. Machine learning models predict which consumers are most receptive to sustainability messaging, optimizing the prominence of environmental information in product displays.Fashion retailers employ computer vision to analyze garment lifecycle impacts, tracking materials from source through manufacturing, use, and disposal. AI-powered virtual try-on technologies reduce return rates, thereby decreasing transportation emissions associated with reverse logistics. Personalized style recommendation systems suggest sustainable fashion choices aligned with individual preferences, making sustainable fashion accessible without requiring extensive consumer research. Chatbot interfaces educate consumers about garment care practices that extend product lifespan and provide information about recycling programs.

B. Food and Agriculture

Agricultural technology companies leverage AI for precision marketing of sustainable food products. Machine learning systems analyze growing conditions, inputs, and practices to generate verified sustainability scores for agricultural products. These scores inform consumer-facing labels and marketing communications, providing objective metrics rather than subjective claims. Natural language generation creates detailed product stories explaining

farming practices, environmental stewardship, and community impacts in engaging narratives tailored to different consumer segments. Grocery retailers implement AI-powered apps that help consumers make sustainable food choices. These applications scan product barcodes to provide instant environmental impact assessments, suggest lower-impact alternatives, and track cumulative environmental footprints across shopping trips.

Recommendation systems encourage plant-based alternatives by suggesting recipes and products aligned with dietary preferences while highlighting environmental benefits. Dynamic pricing algorithms offer incentives for purchasing items approaching expiration dates, reducing food waste through targeted promotions.

C. Energy and Utilities

Energy companies employ AI for personalized engagement in renewable energy programs and energy efficiency initiatives. Predictive models identify households likely to adopt solar panels, electric vehicles, or smart home technologies, enabling targeted marketing campaigns. Natural language processing analyzes utility customer service interactions to identify concerns, questions, and misconceptions about renewable energy, informing educational content development. Machine learning systems optimize time-of-use rate communications, presenting complex pricing structures in accessible formats that encourage load shifting to periods with cleaner energy availability. Smart meter data analytics enable hyper-personalized energy conservation recommendations. AI systems identify specific usage patterns and appliance behaviors, generating customized suggestions for efficiency improvements with estimated cost savings and environmental benefits. Gamification elements powered by AI create engaging experiences around energy conservation, comparing household performance against similar homes and providing achievable challenges that drive sustained behavior change.

V. CHALLENGES AND ETHICAL CONSIDERATIONS

A. Algorithmic Bias and Fairness

AI systems may perpetuate or amplify existing biases in environmental marketing, creating equity concerns. Recommendation algorithms trained on historical data might reflect past discrimination in access to sustainable products and services. For example, if sustainable options have been disproportionately marketed to affluent consumers, AI systems may learn to exclude lower-income segments from sustainability messaging, perpetuating environmental justice disparities. Geographic biases emerge when training data overrepresents certain regions, causing AI systems to make inappropriate assumptions about consumer preferences and environmental priorities in underrepresented areas. Fairness in AI-driven green marketing requires explicit consideration of diverse consumer circumstances and values. Algorithms must be evaluated not only for prediction accuracy but also for equitable treatment across demographic groups. This evaluation encompasses access to information about sustainable options, pricing structures for green products, and representation in marketing communications. Addressing algorithmic bias

necessitates diverse development teams, inclusive training data, regular fairness audits, and mechanisms for consumer feedback about perceived discrimination.

B. Data Privacy and Consumer Consent

Effective AI applications in green marketing require extensive consumer data collection and analysis, raising significant privacy concerns. Behavioral tracking necessary for personalization may feel invasive, particularly when it extends to sensitive environmental values and lifestyle choices. The integration of data across multiple sources, while enabling sophisticated insights, also creates comprehensive consumer profiles that could be misused. Smart home devices and IoT sensors that enable environmental impact tracking generate continuous streams of intimate household data requiring careful protection. Privacy-preserving AI techniques offer potential solutions, including federated learning that trains models on decentralized data without centralizing sensitive information, differential privacy that adds carefully calibrated noise to protect individual records while maintaining statistical validity, and homomorphic encryption that enables computation on encrypted data. However, these techniques involve trade-offs between privacy protection and model performance. Transparent data practices, meaningful consent mechanisms, and user control over data sharing and algorithmic personalization represent essential elements of ethical AI deployment in green marketing.

C. Environmental Footprint of AI Systems

The inherent environmental cost of AI systems creates a fundamental tension when applying these technologies to green marketing. Training large machine learning models requires substantial computational resources, generating significant carbon emissions depending on the energy sources powering data centers. Inference operations, while less intensive than training, accumulate environmental impact through continuous real-time processing of consumer interactions. The lifecycle environmental footprint of AI infrastructure encompasses manufacturing of specialized hardware, cooling requirements for data centers, and electronic waste from obsolete equipment. Organizations implementing AI for green marketing must conduct net environmental impact assessments, comparing the benefits of improved sustainability outcomes against the environmental costs of AI operations. Strategies for minimizing AI environmental footprint include using energy efficient algorithms, powering data centers with renewable energy, implementing model compression techniques, sharing pre-trained models across applications, and scheduling non-urgent computations during periods of clean energy availability. Transparent reporting of AI environmental impacts enables informed decisions about technology deployment and drives innovation in sustainable AI development.

D. Transparency and Explainability

The black-box nature of many AI systems challenges transparency requirements in environmental communications. Consumers and regulators increasingly demand clear explanations of how environmental claims are derived and what factors influence sustainability ratings. Complex neural networks that power sophisticated green marketing applications often

resist straightforward explanation, creating tension between model performance and interpretability. This opacity becomes particularly problematic when AI systems make consequential decisions about product environmental claims or sustainability certifications. Explainable AI techniques provide partial solutions, including attention mechanisms that reveal which input features most strongly influence model outputs, local interpretable model-agnostic explanations that approximate complex model behavior with simpler interpretable models, and counterfactual explanations that describe how inputs would need to change to alter outcomes. However, these techniques often provide approximations rather than complete transparency. Regulatory frameworks increasingly mandate explainability in automated decision-making, requiring organizations to balance AI sophistication with accountability demands.

VI. FUTURE TRENDS AND OPPORTUNITIES

A. Integration with Circular Economy Platforms

Emerging applications integrate AI with circular economy infrastructure, enabling closed-loop product systems. Computer vision facilitates automated product identification and condition assessment in takeback programs, while machine learning optimizes reverse logistics networks for product returns and recycling. AI-powered material marketplaces match waste streams with potential users, transforming disposal challenges into resource opportunities. Predictive maintenance systems extend product lifecycles by anticipating failures and scheduling timely interventions, reducing premature disposal.

Product-as-a-service models enabled by AI tracking and management systems shift consumer relationships from ownership to access, aligning business incentives with durability and resource efficiency. AI systems monitor product usage, optimize utilization rates across shared user bases, and coordinate maintenance and redistribution. Marketing for circular business models requires different approaches than traditional product sales, emphasizing value delivery, service quality, and environmental benefits of shared consumption patterns. AI personalization helps communicate these novel value propositions effectively to diverse consumer segments.

B. Enhanced Reality and Immersive Experiences

Augmented and virtual reality technologies powered by AI create immersive environmental education experiences. These applications enable consumers to visualize product lifecycle impacts, explore manufacturing facilities virtually, witness ecosystem restoration projects supported by purchases, and experience potential environmental futures resulting from collective consumption choices. AI systems personalize these experiences based on individual interests and knowledge levels, maintaining engagement while communicating complex environmental concepts. Spatial computing and mixed reality enable innovative sustainability communications, such as overlaying real-time environmental data onto physical products through smartphone cameras, providing contextual information about sustainable alternatives when shopping, and creating persistent virtual spaces for community engagement around environmental initiatives.

These immersive experiences strengthen emotional connections to sustainability issues while providing practical information that influences purchasing decisions.

C. Autonomous Environmental Monitoring

Autonomous systems combining AI with sensor networks enable continuous environmental monitoring across supply chains. Satellite imagery analysis detects deforestation, verifies sustainable agriculture practices, and monitors industrial emissions. IoT sensor deployments in manufacturing facilities provide real-time data on resource consumption, waste generation, and pollution. Drone systems conduct environmental audits of remote or difficult-to-access locations. These autonomous monitoring capabilities enable verified, real-time environmental claims rather than periodic self-reporting, fundamentally strengthening credibility of green marketing communications. Blockchain integration creates immutable records of autonomous monitoring data, enabling transparent tracking from raw material sourcing through end-of-life processing. Smart contracts automatically verify compliance with environmental standards and trigger certifications or penalties based on measured performance. This infrastructure supports consumer-facing applications that provide instant verification of environmental claims through simple product scans, transforming green marketing from persuasive communication to objective information provision.

VII. BEST PRACTICES AND RECOMMENDATIONS

A. Strategic Implementation Framework

Organizations seeking to implement AI in green marketing should adopt a systematic approach beginning with clear objective definition. Specific goals might include improving targeting accuracy for sustainable product promotions, reducing greenwashing risks through automated claim verification, enhancing consumer education about environmental impacts, or optimizing resource allocation in sustainability campaigns. Clear objectives enable appropriate technology selection, performance measurement, and continuous improvement. Data infrastructure development represents a critical foundation, encompassing collection systems for consumer behavior data, integration of environmental performance metrics, and establishment of data governance protocols ensuring quality, privacy, and ethical use. Organizations should invest in first-party data collection rather than relying solely on third-party sources, building direct relationships with consumers while maintaining control over data practices. Cross-functional collaboration between marketing, sustainability, data science, and legal teams ensures holistic consideration of business, environmental, technical, and ethical dimensions.

B. Ethical Guidelines

Ethical AI deployment in green marketing requires explicit commitments to authenticity, transparency, fairness, and environmental net benefit. Authenticity demands that AI-enhanced communications reflect genuine environmental performance rather than amplifying misleading claims. Regular audits should verify alignment between marketing messages and documented

sustainability practices. Transparency extends beyond data practices to include disclosure of AI use in content generation, personalization, and decision-making. Consumers should understand when they interact with AI systems and how these systems influence their experiences. Fairness requires proactive measures to prevent algorithmic bias, including diverse representation in training data, regular fairness assessments across demographic groups, and mechanisms for bias reporting and correction. Environmental net benefit necessitates explicit accounting of AI system environmental costs against anticipated sustainability improvements, with commitment to minimize AI footprint through efficient algorithms, renewable energy use, and carbon offsetting where elimination proves infeasible.

C. Measurement and Evaluation

Comprehensive evaluation of AI applications in green marketing encompasses multiple dimensions beyond traditional marketing metrics. Effectiveness measures should include environmental outcome indicators such as consumer adoption rates of sustainable alternatives, reductions in overall consumption footprint among engaged consumers, and influence on broader sustainability awareness and behavior. Campaign efficiency metrics assess resource optimization, cost per sustainable conversion, and scalability of AI-driven approaches compared to traditional methods. Ethical performance indicators track algorithmic fairness across demographic groups, data privacy compliance, transparency in AI use disclosure, and net environmental impact of AI operations. Consumer trust metrics assess perceived authenticity of environmental claims, confidence in sustainability information, and willingness to engage with AI-driven sustainability features. Regular assessment across these dimensions enables continuous improvement while identifying emerging risks requiring mitigation.

VIII. CONCLUSION

Artificial intelligence offers transformative capabilities for green marketing, enabling sophisticated consumer engagement, personalized sustainability communications, and enhanced credibility through verified environmental claims. The convergence of machine learning, natural language processing, computer vision, and predictive analytics addresses fundamental challenges in environmental communication while creating opportunities for innovative approaches to sustainable consumer engagement. Applications across retail, agriculture, energy, and other sectors demonstrate significant potential for AI to enhance both marketing effectiveness and environmental outcomes. However, realizing this potential requires careful attention to ethical considerations, including algorithmic bias, data privacy, transparency, and the environmental cost of AI systems themselves. The paradox of using resource-intensive technologies to promote sustainability demands explicit accounting of net environmental impact and commitment to minimizing AI footprint. Organizations must balance the sophisticated capabilities of AI with the authenticity, transparency, and accountability essential for credible environmental communication.

The future of AI in green marketing lies not in technological sophistication alone but in thoughtful integration of AI capabilities with genuine sustainability commitment, ethical data

practices, and consumer-centric design. Success requires moving beyond the view of AI as merely a marketing optimization tool toward recognition of AI as an infrastructure supporting systemic transformation in how businesses communicate environmental value and engage consumers in sustainability initiatives.As AI technologies continue advancing and environmental urgency intensifies, the intersection of artificial intelligence and green marketing will increasingly define sustainable business practice.

Organizations that adopt strategic, ethical, and transparent approaches to AI implementation position themselves as leaders in this evolving landscape, building consumer trust while contributing to meaningful environmental progress. The challenge and opportunity ahead lie in ensuring that AI serves authentic sustainability rather than merely sophisticated persuasion, ultimately contributing to the fundamental transformation in consumption patterns required to address global environmental challenges.

REFERENCES

- Peattie, K., and Crane, A., Green marketing: Legend, myth, farce or prophesy? Qualitative Market Research: An International Journal, Vol. 8, No. 4, pp. 357-370, 2005.
- Polonsky, M.J., Transformative green marketing: Impediments and opportunities. Journal of Business Research, Vol. 64, No. 12, pp. 1311-1319, 2011.
- Dwivedi, Y.K., et al., Artificial Intelligence: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International Journal of Information Management, Vol. 57, Article 101994, 2021.
- Vinuesa, R., et al., The role of artificial intelligence in achieving the Sustainable Development Goals. Nature Communications, Vol. 11, Article 233, 2020.
- Dauvergne, P., AI in the Wild: Sustainability in the Age of Artificial Intelligence. MIT Press, Cambridge, MA, 2020.
- Chen, Y.S., and Chang, C.H., Greenwash and green trust: The mediation effects of green consumer confusion and green perceived risk. Journal of Business Ethics, Vol. 114, No. 3, pp. 489-500, 2013.
- Huang, M.H., and Rust, R.T., Artificial Intelligence in Service. Journal of Service Research, Vol. 21, No. 2, pp. 155-172, 2018.
- Davenport, T., Guha, A., Grewal, D., and Bressgott, T., How artificial intelligence will change the future of marketing. Journal of the Academy of Marketing Science, Vol. 48, No. 1, pp. 24- 42, 2020.
- Strubell, E., Ganesh, A., and McCallum, A., Energy and policy considerations for deep learning in NLP. Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics, pp. 3645-3650, 2019.
- Schwartz, R., et al., Green AI. Communications of the ACM, Vol. 63, No. 12, pp. 54-63, 2020.
- Mittelstadt, B.D., Allo, P., Taddeo, M., Wachter, S., and Floridi, L., The ethics of algorithms: Mapping the debate. Big Data & Society, Vol. 3, No. 2, 2016.

- White, K., Habib, R., and Hardisty, D.J., How to SHIFT Consumer Behaviors to be More Sustainable: A Literature Review and Guiding Framework. Journal of Marketing, Vol. 83, No. 3, pp. 22-49, 2019.
- Jarrahi, M.H., Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. Business Horizons, Vol. 61, No. 4, pp. 577-586, 2018.
- Rolnick, D., et al., Tackling Climate Change with Machine Learning. ACM Computing Surveys, Vol. 55, No. 2, Article 42, 2022.
- Verma, S., and Rubin, J., Fairness definitions explained. Proceedings of the International Workshop on Software Fairness, pp. 1-7, 2018.
- Kumar, V., Rajan, B., Venkatesan, R., and Lecinski, J., Understanding the role of artificial intelligence in personalized engagement marketing. California Management Review, Vol. 61, No. 4, pp. 135-155, 2019.
- Gursoy, D., Chi, O.H., Lu, L., and Nunkoo, R., Consumers acceptance of artificially intelligent (AI) device use in service delivery. International Journal of Information Management, Vol. 49, pp. 157-169, 2019.
- Kaplan, A., and Haenlein, M., Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. Business Horizons, Vol. 62, No. 1, pp. 15-25, 2019.
- Delmas, M.A., and Burbano, V.C., The drivers of greenwashing. California Management Review, Vol. 54, No. 1, pp. 64-87, 2011.
- Ottman, J.A., Stafford, E.R., and Hartman, C.L., Avoiding green marketing myopia: Ways to improve consumer appeal for environmentally preferable products. Environment: Science and Policy for Sustainable Development, Vol. 48, No. 5, pp. 22-36, 2006.
- Pappas, I.O., Mikalef, P., Giannakos, M.N., Krogstie, J., and Lekakos, G., Big data and business analytics ecosystems: paving the way towards digital transformation and sustainable societies. Information Systems and e-Business Management, Vol. 16, No. 3, pp. 479-491, 2018.
- Chatterjee, S., and Bhattacharjee, K.K., Adoption of artificial intelligence in higher education: A quantitative analysis using structural equation modelling. Education and Information Technologies, Vol. 25, No. 5, pp. 3443-3463, 2020.
- de Bruyn, A., Viswanathan, V., Beh, Y.S., Brock, J.K.U., and von Wangenheim, F., Artificial Intelligence and Marketing: Pitfalls and Opportunities. Journal of Interactive Marketing, Vol. 51, pp. 91-105, 2020.
- Dangelico, R.M., and Vocalelli, D., Green Marketing: An analysis of definitions, strategy steps, and tools through a systematic review of the literature. Journal of Cleaner Production, Vol. 165, pp. 1263-1279, 2017.
- Huang, M.H., and Rust, R.T., A strategic framework for artificial intelligence in marketing. Journal of the Academy of Marketing Science, Vol. 49, No. 1, pp. 30-50, 2021.