AI in Green Marketing: Driving Sustainable Consumer Behaviour through Personalization

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Abstract—**Despite the growing adoption of green marketing by businesses to target eco-friendly customers, its effectiveness is often compromised by greenwashing and overly broad marketing tactics. As a result consumers are losing trust and becoming disengaged, resulting in an overwhelming need for customized, transparent, and authentic sustainability communications. This paper examines the lack of trust in green marketing and argues that better alignment with consumer values and behavioral intent towards sustainable products can be achieved through AI-driven personalization. Technologies, such as recommender systems and sentiment analysis are proposed to support this alignment. To meet this goal, we propose a conceptual AI and machine learning tool that is set to change how branded messages are delivered to prospective consumers. This tool is built using a three-tiered framework that includes an AI-powered recommender system that targets individual customers with relevant green products, real-time sentiment analysis and feedback systems to adjust brand communication based on public sentiment and natural language processing (NLP) tools to detect and filter greenwashed content from marketing campaigns. We ground our framework around recent case studies and contemporary research from pioneers in sustainability such as Unilever and Amazon, associating particular AI tools with notable challenges within green marketing. A planned outcome is a strategic design model that aids businesses in utilizing AI technologies for personalizing green messages, rebuilding consumer trust, and reinforcing the alignment of the brand with sustainability objectives. The model is intended to be cross-sector; therefore it also incorporates AI ethical principles such as transparency, data stewardship, and user-centered design. Additionally, we propose a set of trust indicators and engagement metrics that will support evaluation of future implementations.**

Keywords—*AI in Marketing, Green Marketing, Sustainable Consumer Behavior, Personalization, Customer Trust, Ethical AI*

I. INTRODUCTION

Lately, sustainability has become the essential factor for consumers as well as businesses. To keep up with the market's growing eco-consciousness, businesses have resorted to green marketing, which involves promoting eco-friendly goods, services. However, the growing issue of greenwashing, i.e., misleading or lack of transparency in environmental claims that undermine consumer trust—has raised doubts about the efficiency of sustainability messaging, despite its rising popularity. (Chen & Chang, 2013; United Nations Environment Programme, 2021)

Today, consumers are increasingly skeptical of the ambiguous sustainability messaging as they become more knowledgeable about it. Looking at the famous scandals involving Volkswagen, H&M, and Keurig, we can all see the problems companies face when their environmental claims are not backed up by action and transparency. As a result, there is an increasing lack of trust in green marketing, endangering the credibility of brands as well as the larger sustainability movement. (Volkswagen AG, 2020; Netherlands Authority for Consumers and Markets, 2022; Canadian Competition Bureau, 2022; Rahman, Park, & Chi, 2015)

In this paper, we address the growing distrust of the public in green marketing and propose that artificial intelligence (AI) can help in rebuilding that trust. By using technologies like recommendation systems, sentiment analysis, and natural language processing (NLP), we can create highly personalized, transparent, and responsive messaging that promotes authentic sustainability efforts. (Chen & Chang, 2013; Rahman et al., 2015)

To this, we propose a three-tier AI framework designed to increase the trust the public has in green marketing by aligning brand messaging with consumer expectations and regulatory demands. Based on the real-world case studies we can conclude the AI capabilities to green marketing challenges and define a set of metrics for evaluating their impact. (Jannach & Adomavicius, 2016; Liu, 2012)

The rest of the paper is structured as follows: Section 2 reviews literature on trust in green marketing and the role of AI in personalization and messaging. Section 3 highlights real-world cases of greenwashing and their consequences. Section 4 presents our proposed framework. Section 5 outlines evaluation metrics, followed by discussion and conclusion in Sections 6 and 7, respectively.

II. LITERATURE SURVEY

A) Green Marketing and Consumer Trust

Green marketing is the process of developing and advertising products based on their environmental sustainability. Green marketing is one component of a broader movement toward socially and environmentally conscious

business practices. Gradually, consumers have come to expect companies to show their commitment to improving their operations alongside various ESG criteria. To that end, companies are working hard and periodically do a self-report to show their progress towards these goals. (United Nations Environment Programme, 2021)

The credibility of green marketing has come under increasing scrutiny of late. Consumers have grown more skeptical as instances of greenwashing—companies making exaggerated or unsubstantiated environmental claims—have multiplied. Research by Chen and Chang (2013) demonstrates that when green marketing messages are vague or unverifiable, consumer trust and purchase intention decline significantly. Rahman et al. (2015) further emphasize that trust is a critical link that ties green brand positioning and customer loyalty together, highlighting its role in effective sustainability communication.

Recent events beyond the academic sphere reinforce these observations. The United Nations Environment Programme (2021) explicitly warned that vague environmental assertions and unsubstantiated claims of sustainability are eroding public confidence and, consequently, threatening the legitimacy of authentic environmental initiatives. Well-documented incidents involving companies such as Volkswagen, Toyota, and H&M—each facing scrutiny for questionable eco-labeling —illustrate how greenwashing can have serious consequences, including financial penalties, reputational damage, and a loss of consumer trust. (United Nations Environment Programme, 2021; Volkswagen AG, 2020; Netherlands ACM, 2022)

In light of these events, trust is not a desirable outcome of green marketing; it is an essential prerequisite for success. Rebuilding this trust requires transparency. Within this evolving industry, artificial intelligence is emerging as a key instrument, enabling organizations to communicate their sustainability efforts with greater credibility and effectiveness. (Tam & Ho, 2005; Kim & Han, 2019)

B) Artificial Intelligence in Marketing

Artificial Intelligence (AI) has shown vast potential in modern marketing. It aids in decision-making, real-time customer engagement, and hyper-personalized experiences through understanding the data. Through tools like recommender systems, sentiment analysis, and natural language processing (NLP), AI allows marketers to move beyond one-size-fits-all messaging and tailor content to individual preferences, behaviors, and emotional responses.

Recommender systems are widely used to personalize product suggestions based on user behavior, browsing history, and preference patterns. Studies by Jannach and Adomavicius (2016) highlight that AI-powered recommendations increase user satisfaction, engagement, and purchase intention. These systems are particularly effective in sustainability-focused contexts, where customers respond better to eco-friendly products that match their values or lifestyle.

Sentiment analysis, which uses machine learning and NLP to detect emotional tone in text or speech, allows marketers to monitor public reactions to campaigns, brand mentions, or social issues. According to Liu (2012), sentiment analysis supports real-time campaign adjustments and enhances customer feedback interpretation. In green marketing, this helps detect early signs of skepticism, backlash, or misunderstanding which is the key to managing trust.

Natural Language Processing (NLP) is also increasingly applied to analyze marketing language and assess credibility of the claims. NLP can flag inconsistencies or exaggerations in marketing content and compare brand language with verifiable sustainability standards or certifications. This is very important in the context of greenwashing, where unverified claims can do immense damage to the reputation of a company.

Together, these AI technologies enable businesses to understand and respond to consumer sentiment, behaviors, and values with unprecedented precision. The next section explores how these tools can be applied specifically to green marketing as a trust-building mechanism.

C) AI as a Trust-Repair Mechanism in Green Marketing

Green marketing, in theory, has significant potential to drive real sustainability efforts. Yet, its effectiveness is minimum when consumers see a lack of authenticity or detect manipulative tactics. Restoring trust in this sphere requires marketers to go beyond surface-level messaging; they must provide transparency, align campaigns with individual consumer values, and support their claims with credible evidence.

Artificial intelligence offers a great set of tools that we can use to increase credibility. Research over the years has proven that personalized messaging has increased the relevance to the consumers, leading to enhanced trust and more positive behavioral responses (Tam & Ho, 2005; Kim & Han, 2019). In green marketing, AI-powered recommendation systems can suggest products that align with people's values and their daily lifestyle. This approach positions sustainability as attainable and personally significant.

Additionally, sentiment analysis allows brands to monitor and interpret public feedback in real time. By detecting early signs of dissatisfaction or skepticism, companies can proactively adjust messaging, thereby mitigating potential reputational risks. Such responsiveness signals a brand's attentiveness to its audience—an essential component of building trust (Gefen et al., 2003).

In addition, Natural Language Processing (NLP) can help us detect and prevent greenwashing. By analyzing the consistency and substantiation of environmental claims, NLP tools can identify ambiguous or unverifiable claims in marketing content. Using these can help companies align with the regulatory standards (such as the FTC Green Guides and the EU Green Claims Directive) and bolster consumer confidence.

In conclusion, AI supports a meaningful shift from generalized, claim-heavy green marketing to communication that is personalized, responsive, and verifiable. When used ethically and with transparency, these technologies can help repair trust and restore brand credibility in an era of increasing skepticism toward environmental claims.

III. REAL WORLD CASE EVIDENCE

The academic literature makes it clear that trust is central to the effectiveness of green marketing, but looking at the real-world examples, we can say that this is not a theoretical issue but a real and core issue in the system. These cases showcase that lack of trust is a widespread problem and there is an urgent need for restoring the trust.

One of the most infamous examples is Volkswagen's Dieselgate scandal, where it installed software in over 11 million vehicles that reports lower emissions. After the claims

had been investigated, the company paid over $34 billion in fines globally. This scandal severely damaged the reputation of the brand and also attracted skepticism from consumers on environmental claims in the automobile industry.

In addition, Toyota was fined $180 million in 2021 by the United States Department of Justice for the delay of mandatory emission defect reports. Although Toyota advertises itself as an environmentally friendly brand, its failures in disclosing emissions-related issues in a timely manner contribute to an increasing awareness of corporate greenwashing.

Goldman Sachs, DWS, and BNY Mellon were individuals charged with misrepresenting the ESG stake standard in the investment industry. The United States. The SEC alleges that these companies exaggerated their environmental certificates without adequate due diligence, thus undermining confidence in long-term financing.

The manner in which goods are sold by H&M and Decathlon was investigated by the Dutch regulators for using obscure terms such as 'conscious choice' and 'ecodesign' without providing adequate evidence. Both companies agreed to remove such a label and contribute to the sustainability causes. Meanwhile, Keurig was fined in Canada for misleading consumers about the possibility of recycling their coffee pods, a situation that reveals the way in which partial disclosure may lead to a decrease in consumers' trust in the company even when the intention is for a greater purpose.

The above cases illustrate the multi-industry nature of greenwashing and its long-term consequences, i.e., the loss of consumer confidence, economic sanctions, lawsuits, and public opinion. This reveals a common thread, a gap between corporate claims and verifiable behavior.

The events described above illustrate the pressing need for tools that validate claims, personalize connections, and monitor social sentiment—precisely the function that AI systems can perform. A structured AI system designed to deal with the abovementioned challenges is described in the following part.

IV. PROPOSED FRAMEWORK: AI-ENABLED GREEN MARKETING

A) Overview of the 3-Tier Architecture

A three-tier framework is proposed to increase transparency, personalization, and authenticity in the sustainability claims made by companies. which helps us in solving the problem of growing distrust of the companies.

1. Tier 1 – Recommender Systems: Deliver tailored green product recommendations based on consumer behavior, preferences, and environmental values.

2. Tier 2 – NLP-Based Greenwashing Detection: Analyze marketing content to identify vague or misleading claims.

3. Tier 3 - Sentiment Analysis and Feedback Systems: Monitor consumer sentiment and adjust campaign tone and messaging in real time. Each layer plays a critical role in reducing the risk of greenwashing and restoring the trust of consumers.

B) Tier 1: AI-Powered Recommender Systems

Recommendation systems use the browsing history and purchase behavior of users to deliver personalized product suggestions. In green marketing, this helps in recommending

products that align with the user's lifestyle and their priorities.

By using these user-specific marketing suggestions, users will feel that their needs are seen and understood, which helps to increase their trust in the companies. For example, Unilever used machine learning models to identify environmentally conscious consumers and promoted various products like refillable packaging or plant-based alternatives. This not only increases engagement but also reinforces a brand's credibility as a sustainability partner, not just a seller. (Jannach & Adomavicius, 2016; Kim & Han, 2019)

C) Tier 2: NLP- Based Greenwashing Detection

Natural language processing (NLP) can be used to analyze the sustainability marketing claims by analyzing the language, word choice and tone of the message. We can detect phrases that are vague or feel exaggerated, which are common traits of greenwashing.

For example, terms like "eco-friendly," "green," or "sustainable" are meaningless without specific context or proof. NLP can detect such terms and help companies cross-reference those claims with its data, third-party certifications, or established standards. Integrating NLP into campaign development helps ensure messaging is fact-based and follows regulations, aligning with the emerging green claims regulations in the UK, US, and EU.

Together, these make a holistic system that helps companies in adjusting their values, responsiveness towards customer sentiments, and claim accountability, 3 main pillars that help in building trust in green marketing. (United Nations Environment Programme, 2021; FTC, 2012)

D) Tier 3: Sentiment Analysis and Real-Time Feedback

Sentiment analysis uses AI to perceive consumers' emotions and opinions from various sources like social media and other channels. It can detect consumer skepticism and approval for various sustainability messaging, which will help companies in understanding their feedback.

This feedback allows marketers to adjust their messaging in real time. For instance, if a campaign about "zero plastic campaigning" receives negative sentiment by users due to lack of clarity, the marketer can adjust the messaging to include real-time data, which reinforces the claim.

This not only minimizes the reputational damage but also increases trust in consumers because of the prompt responsiveness.

Real-time sentiment monitoring also allows us to decrease the trust deterioration in consumers by detecting signs of greenwashing early. (Liu, 2012).

V. EVALUATION METRICS

To assess the effectiveness of AI-enabled green marketing frameworks, we outline a set of quantitative and qualitative metrics focused on three main pillars: trust recovery, consumer engagement, and ethical compliance. These metrics are designed to produce actionable insights for assessing performance and to guide future improvements.

A) Trust Indicators

These metrics assess how the consumer trust in green marketing is varying.

TABLE I.

Metric	Description
Brand Trust Score	Measured through surveys or third-party platforms to gauge consumer confidence in sustainability claims
Perceived Authenticity	Consumer feedback on whether green message feels credible, specific and value-aligned
Reduction in Greenwashing Perception	Survey-based or sentiment analysis of social media discussions about the brand's sustainability claims
Sustainability Certification Verification	Proportion of green claims backed by third-party certifications (e.g., B Corp, Fairtrade, ISO 14001)

(Chen & Chang, 2013; Rahman et al., 2015; Gefen et al., 2003)

B) Engagement Metrics

These evaluate how personalization and responsiveness influence consumer interaction with green products.

TABLE II.

Metric	Description
Click-through Rate	Percentage of users clicking on AI-personalized eco-product recommendations
Conversion Rate	Ratio of green product recommendations that result in purchases
Bounce Rate Reduction	Comparison of bounce rates on sustainability-focused landing pages before and after AI integration
Repeat Interaction Frequency	Number of return visits or interactions with green product categories

(Tam & Ho, 2005; Kim & Han, 2019; Jannach & Adomavicius, 2016)

C) Ethical and Regulatory Compliance

These metrics help ensure the system adheres to data ethics, privacy, and green marketing regulations.

TABLE III.

Metric	Description
Transparency Score	Assessment of how clearly AI-generated content discloses data sources, recommendation logic, and sustainability evidence
Green Claim Audit Pass Rate	Frequency of passing internal or third-party audits for green claim accuracy
Data Privacy Compliance	Compliance with GDPR, FTC Green Guides, or other relevant data regulations for AI-based personalization

(United Nations Environment Programme, 2021; Federal Trade Commission, 2012; European Commission, 2021)

VI. DISCUSSION

The growing resistance to greenwashing indicates that marketing teams now need to focus on being honest, clear, and real with people. This paper argues that when companies use AI in the right way, it can help them reach these goals. The three-step AI framework uses recommender systems, sentiment analysis, and NLP-based claim validation. These steps help brands win back trust in green marketing.

From a strategic perspective, the framework is adaptable across many industries. In automotive, it can help brands like Volkswagen or Toyota get back people's trust by aligning vehicle promotions with verified emissions data. In retail, companies such as H&M or Walmart can use AI to eliminate vague labels, which helps people find genuine green choices. In finance, where ESG funds are under heavy scrutiny, tools like NLP can check fund descriptions against actual practices. (Volkswagen AG, 2020; Canadian Competition Bureau, 2022; Netherlands ACM, 2022)

However, for successful implementation, you need more than just technology. Marketers need to follow ethical standards for AI. They should make sure that data is kept private, algorithmic transparency is maintained, and regular audits of green claims are conducted. Without this implementation, even the most sophisticated tools risk becoming part of the greenwashing problem.

It's also important to acknowledge limitations. AI systems work based on the quality of the data they use. If you use incorrect input like biased consumer data or unproven environmental claims, it can increase existing trust issues. Moreover, setting up AI can be costly and complex, especially for small businesses, suggesting that the industry might need tools or open-source models that anyone can use.

Ultimately, AI is not a quick fix. But when you use it with care and oversight, AI can serve as a powerful tool in bringing trust back into green marketing.

VII. LIMITATIONS

The integration of AI may look like a perfect system, but several limitations must be considered.

A primary limitation is the framework's fundamental reliance on the availability of high-quality, unbiased data. If the data used for these AI systems lacks accuracy or depth, it may result in misaligned or outright misleading information. Incorrect personalization or a failure to identify deceptive greenwashing claims could severely undermine the framework's credibility.

Additionally, the framework may be resource intensive, requiring significant investments in both technological infrastructure and skilled personnel, which may place a large burden on organizations with limited financial or technical resources. For smaller enterprises, these barriers may be insurmountable.

Moreover, NLP-based tools' detection of nuanced forms of communication—such as sarcasm, indirect references, or culturally specific idioms—remains limited. This may be a challenge when the language is nuanced with ambiguity or layered with subtexts. Finally, the AI-driven personalization may look manipulative or invasive from the user's perspective. So without a strong emphasis on transparency, the systems may risk increasing users' distrust.

VIII. FUTURE SCOPE

Although the framework has its limitations, it does have potential for future research and practical application.

One option is to test the framework in different industries, evaluating its effect on consumer trust, messaging efficacy, and sustainability perception. Adapting the model to specific sectors, especially in high-impact domains like fashion, finance, and consumer goods could reveal unique challenges and improve the model.

We can enable immutable tracking and verification of green claims by integrating blockchain technologies into our framework. This approach would significantly bolster accountability, as it prevents data manipulation and ensures each claim is transparently recorded.

Simultaneously, there is a clear necessity for the development of open-source, ethics-oriented AI tools designed specifically for green marketing, particularly for small and medium-sized enterprises that often face resource constraints. Additionally, ensuring that the framework aligns

with current international regulatory standards, such as the EU Green Claims Directive and the UK's Green Claims Code, will be essential for maintaining compliance and securing long-term sustainability.

IX. CONCLUSION

Green marketing, though vital for promoting sustainable consumption, is losing credibility due to ambiguous messaging and extensive greenwashing. The main obstacle undermining the effectiveness of sustainability communication is the consumer trust deficit identified in this paper. In response, we proposed a three-tier artificial intelligence framework meant to individualize green messaging, track public opinion, and validate environmental claims in reaction.

Through a review of academic research, actual greenwashing examples, and AI technologies, we demonstrated how recommender systems, sentiment analysis, and NLP might be applied not only to enhance marketing performance but also to regain public trust in sustainability stories.

In an era of rising eco-skepticism and tightening regulations, companies have to move beyond superficial green messaging. Green marketing should be transparent, data-driven, and responsive; AI can assist in fulfilling this vision if used ethically. For now, the message is simple and clear: gaining consumer trust is the new competitive edge; it is no longer optional.

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