Received: 14 September 2023 | Revised: 18 July 2024 | Accepted: 6 September 2024

DOI: 10.1111/caim.12639

RESEARCH ARTICLE

WILEY

Shades of green deception—An empirical examination into the consequences of greenwashing of innovations

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The urgency to launch sustainable innovations rapidly in competitive markets increases the risk of greenwashing, as companies may overstate their products' environmental benefits. This article sheds light on the potential repercussions of deceptive sustainability claims within the realm of product innovations. Using four scenario-based experiments, this study reveals that exposure of greenwashing damages brand perception, a critical factor in the diffusion of innovations, even more than if products lacked green attributes at all. Findings from mediation analyses reveal that these reactions stem from negative disconfirmations, arising from a perceived discrepancy between expected sustainability and quality beliefs and the product's failure to meet these expectations. Moreover, this research deepens our understanding of greenwashing by providing the first empirical evidence that the intensity and focus of greenwashing activities on core components of product innovations significantly exacerbate the adverse effects. Overall, our study not only replicates findings on the detrimental effects of greenwashing in product innovation contexts but also advances the theoretical understanding by identifying the psychological processes behind these effects and their variations with greenwashing intensity and focus. In doing so, results advocate for a shift from a one-dimensional, uniformly perspective to a more nuanced understanding of the interplay between greenwashing intensity and focus on consumer responses. From a practical perspective, the results underscore the risks of greenwashing in sustainable innovation contexts and emphasize the crucial role of transparency and authenticity in sustainability claims.

KEYWORDS
brand perception, corporate communication, green deception, green marketing, greenwashing, sustainable innovation

(Manuscript ID CIM-23-0413.R1).

1 | INTRODUCTION

Although environmental marketing has already been used for several decades, incorporating environmentally friendly attributes as a key selling point is currently emerging as an essential strategy for numerous companies (Claudy et al., 2016; Xue & Swan, 2023). This strategy is a response to evolving consumer needs, with an increasing number of consumers changing their behaviour to adopt sustainable consumption practices (Caruana & Crane, 2008; Jain et al., 2021). Companies are realigning their marketing strategies to the growing awareness of environmental friendliness (Prakash, 2002; Sigurdsson & Candi, 2020), leading to an increase in the introduction of innovative sustainable products alongside their conventional counterparts (Olsen et al., 2014) as the shift towards sustainable innovations harbours the potential to enhance companies' competitiveness (Hermundsdottir & Aspelund, 2021). These product innovations are often branded as 'natural', 'environmentally friendly', 'ecological' or 'green' (Baum, 2012; Shahrin et al., 2017). However, this development also revealed a darker side, showing that some companies are capitalizing on consumers' environmental concerns without truly committing to environmentally friendly practices (Pimonenko et al., 2020). This approach is now known as 'greenwashing', defined as the 'act of misleading consumers regarding the environmental practices of a company or the environmental benefits of a product or service' (TerraChoice, 2007, p. 1).

Although prior research has investigated negative effects of greenwashing awareness among consumers (Chen & Chang, 2013; De Jong et al., 2018), the specific impact on consumer behaviour towards innovative sustainable products remain largely unexplored. This is surprising given the urgency for companies to innovate sustainably, potentially increasing greenwashing practices. The allure of presenting innovations as 'green' or 'sustainable' without fully meeting these claims can be particularly tempting in highly competitive and innovative markets where sustainability credentials can influence consumer choice. Furthermore, consumers often perceive sustainable innovations as risky (Wiedmann et al., 2011), leading to caution towards sustainability claims in innovation contexts. Consequently, disillusionment caused by greenwashing may intensify its adverse effects for innovative sustainable products. Moreover, greenwashing significantly affects brand perception (Akturan, 2018; Bladt et al., 2023; Szabo & Webster, 2021), crucial for innovation acceptance and diffusion (Brexendorf et al., 2015). In this unique context, our study aims to shed light on how greenwashing impacts consumers' brand perception of sustainable innovations when exposed, compared to scenarios without sustainable claims.

Furthermore, understanding the underlying psychological mechanisms of consumer reactions to greenwashing-induced brand perception deteriorations is essential. Whilst initial efforts to decipher these mechanisms have been made (Santos et al., 2023; Sun & Shi, 2022; Xiao et al., 2022), research remains limited. To explain these potential deteriorations, the expectation disconfirmation theory (EDT, Aji & Sutikno, 2015; Chen et al., 2019; Ha et al., 2022) might provide a theoretical anchor, highlighting the gap between expectations and reality. In the case of greenwashing of sustainable innovations, this issue might be particularly relevant to the sustainability promise, where consumers may feel deceived because of the non-existence of the proclaimed sustainable value. In order to close this research gap, this study aims to investigate the psychological mechanisms driving the deterioration of brand perception due to greenwashing using EDT as theoretical anchor.

Additionally, current literature predominantly adopted a one-dimensional perspective on greenwashing, often overlooking varying intensities of greenwashing claims (Lyon & Maxwell, 2011; Yang et al., 2020). Whilst recent studies have differentiated between types of green claims (De Jong et al., 2020), or communication levels (Torelli et al., 2020), they lack insight into varying greenwashing intensities, especially for sustainable innovations. This gap is critical because consumers frequently favour green innovations based on their values and social norms (Ozaki, 2011). Hence, the level of greenwashing can impact consumers' brand perception, depending on the extent to which the actual perceived sustainable value fulfils the promised sustainable values. Responding to this research gap, this study aims to address this gap by investigating how different greenwashing levels affect consumers brand perceptions in sustainable innovations contexts.

Beyond the severity of greenwashing, the specific product components targeted by greenwashing claims could also play a crucial role in the context of sustainable innovations. In this regard, prior research suggests that innovative products can be divided into different components (Goldenberg et al., 1999)—core components and peripheral components (Gatignon et al., 2002). Core components are the essential parts of an innovation that often define the key functionalities and performance of the new product (e.g. electric drive technology in electric vehicles). Conversely, peripheral components represent the parts of an innovation that are less central to its main functionality (e.g. the bodywork of electric vehicles) (Gatignon et al., 2002; Ma et al., 2015). Moving research efforts to this granular view of the product components is in line with the previous debate on the need for a more differentiated approach to analysing greenwashing effects. Applying this distinction to sustainable innovations suggests that the negative impact of greenwashing could be more pronounced when it comes to misleading claims about core components, because of their central role in the sustainable value proposition of the product. Given the lack of empirical evidence on the severity of greenwashing the core and peripheral components, this work is dedicated to empirically investigating these assumptions.

To address the shortcomings discussed above, this article presents four studies, utilizing scenario-based experiments, to understand the effects of greenwashing of sustainable innovations on brand perceptions, guided by the following research questions:

1. How does revealed greenwashing of innovations affect consumers' brand perceptions?
2. What psychological mechanisms are triggered in consumers upon recognizing greenwashing practices in innovation contexts?
3. How do variations in the severity of greenwashing practices affect consumer reactions to greenwashed sustainable innovations?
4. How do variations in the focus of greenwashing practices affect consumer reactions to greenwashed sustainable innovations?

Study 1 is dedicated to answer the first research question by analysing how greenwashing of sustainable innovations influences consumers' brand perception. Study 2 aims to delve deeper into the findings of Study 1, employing mediators theoretically anchored in expectancy disconfirmation theory to elucidate the psychological mechanisms behind the observed effects, and thus addresses research question two. Finally, Study 3 examines the influence of different levels of greenwashing of sustainable innovations on consumers brand perception, whereas Study 4 investigates the differential effects of greenwashing across different product components on brand perception. Thus, Studies 3 and 4 aim to respond to the third and fourth research questions.

The findings from our four experiments contribute to our current understanding of consumers reactions to greenwashing practices, especially in the field of innovations. First, confirming and complementing previous research on greenwashing of conventional products (Akturan, 2018; Santos et al., 2024), we were able to replicate the negative effects of greenwashing on brand perception in the context of innovations. This emphasis on innovation is critically important, considering that to maintain long-term competitiveness, companies are compelled to either introduce new sustainable products or adapt existing offerings in a sustainable manner (Przychodzen & Przychodzen, 2018). Second, our study investigates the psychological mechanisms involved when exposed to greenwashing practices, demonstrating how unmet sustainability expectations lead to a decline in consumers' brand evaluations. Hence, we broaden the scope of the still underexplored research field focussing on the explanation of consumer-side psychological processes in greenwashing scenarios. Third, this work empirically differentiates between types of greenwashing, in terms of level and focus, addressing calls for nuanced investigation into its varieties (e.g. Bladt et al., 2023; De Jong et al., 2020). From a managerial perspective, our findings highlight the importance for managers to recognize the risks associated with (revealed) greenwashing, as such practices can hinder the diffusion of innovations by negatively affecting consumers brand perception.

The article is structured as follows: First, we outline the theoretical background and derive our hypotheses. This is followed by the presentation of our four empirical studies. The article concludes with a discussion of the results, theoretical and managerial contributions, and avenues for future research.

2 | CONSUMER REACTIONS TO GREENWASHING OF INNOVATIONS: AN EXPECTANCY DISCONFIRMATION THEORY APPROACH

2.1 | State of research on greenwashing and consumer behaviour

Greenwashing can be defined as 'selective disclosure of positive information about a company's environmental or social performance, without full disclosure of negative information on these dimensions, so as to create an overly positive corporate image' (Lyon & Maxwell, 2011, p. 9). Greenwashing therefore refers to deceptive, disingenuous, ambiguous or misleading statements about the sustainability of a company or product (Yang et al., 2020). This phenomenon is becoming increasingly prevalent, as evidenced by the European Commission finding that 42% of green claims made online across various industries were potentially misleading (European Commission, 2021). Consequently, a major effort of current research is to investigate the effects of greenwashing on consumer perceptions and behaviour (e.g. Braga et al., 2019; Hung & Chang, 2024; Szabo & Webster, 2021). As long as the green claims are not actually questioned or exposed as false, companies can indeed profit from this behaviour (Schmuck et al., 2018). Notably, even if not substantiated by real evidence of green corporate practices, green images and labels can significantly enhance purchase intentions (Spack et al., 2012). Furthermore, companies that proactively communicate involvement regarding environmental protection seem to generate a more positive reputation than those that completely neglect environmental concerns (De Jong et al., 2018). These results indicate that initially, it seems easy to influence consumers with green information and suggest sustainability of new products without providing proof. Conversely, past cases like the Volkswagen emissions scandal have demonstrated that exposing misleading claims can result in significant profit losses, decreased investment and severe reputational damage (Forbes, 2015; Pimonenko et al., 2020). Therefore, it raises the question of what negative consequences may result when consumers become aware of greenwashing practices. In this area, consumer-oriented research has already identified a variety of negative associations: whilst perceived greenwashing increases consumer scepticism (Aji & Sutikno, 2015; Akturan & Nuray, 2019), worsens product perceptions (Braga et al., 2019), reduces purchase intentions (Zhang et al., 2018; Apaolaza et al., 2023; Ahmad & Zhang, 2020) and decreases satisfaction (Martínez et al., 2020). As a result, the focus of research is now primarily shifting to negative effects on consumers' brand perceptions (Akturan, 2018; Chen et al., 2016; Szabo & Webster, 2021). More specifically, a growing body of research shows that exposed greenwashing activities can have negative spillover effects on consumers' perceptions of the participating brand, resulting in lower brand attitudes, brand love and loyalty (Chen et al., 2020; Hameed et al., 2021) as well as negative brand evaluations (Neureiter & Matthes, 2022; Nyilasy et al., 2014). These negative effects can be so far-reaching that a brand's greenwashing behaviour negatively influences consumers' intention to buy green products from other brands within the same industry (Wang et al., 2020). Overall, brand perception thus emerges as a vulnerable asset in the context of greenwashing, primarily because of its fragility. It hinges on consumers' beliefs, making it susceptible to significant and sudden shifts when consumers encounter new information (Dawar & Pillutla, 2000). Whilst initial findings show that greenwashing has negative effects on brand perceptions, current research indicates that further investigation into this relationship is needed (Santos et al., 2023).

The significant impact of deteriorating brand perceptions becomes increasingly apparent when attention shifts from

conventional products to innovative ones. Positive brand perceptions are instrumental in facilitating the introduction and adoption of innovations (Brexendorf et al., 2015). Therefore, as more companies aim to establish themselves as green innovators (Dangelico & Pujari, 2010), conducting thorough research into the potential impacts on brand perception of unsubstantiated green claims seems essential. However, research on the effects of greenwashing in the context of new product introductions is limited. Prior research in related areas has focussed on validating the negative effects of greenwashing on consumer brand perception based on traditional products (Santos et al., 2024; Szabo & Webster, 2021), leaving theoretical rationales and empirical validation of these effects in innovation contexts relatively scarce. Because brand perceptions during the introduction of innovations are crucial for success (Brexendorf et al., 2015), understanding the core impact of greenwashing on brand perception is essential. Therefore, our primary aim is to replicate and confirm the previously identified negative effects of greenwashing on consumer brand perception, specifically in the context of new product launches. Furthermore, this study seeks to investigate these impacts through a theoretical framework rooted in expectancy disconfirmation theory, aiming to illuminate the psychological mechanisms behind these adverse effects. Additionally, it will address particular characteristics of greenwashing in product innovations, including variations in intensity and type.

2.2 | Consumer responses to greenwashing of innovations

Whilst prior studies in the context of greenwashing and consumer responses drew upon attribution theory (Nyilasy et al., 2014), cognitive dissonance (De Jong et al., 2018), and the affect-reason-involvement model (Schmuck et al., 2018) as theoretical anchors, an emerging trend highlights the relevance of expectation-disconfirmation theory (EDT) (Aji & Sutikno, 2015; Chen et al., 2019, 2014). The EDT suggests that consumers reactions depend on the difference between their perceived performance of a product and their prior expectations (Oliver, 1997). More detailed, expectations and perceived outcomes can coincide in different ways. Negative disconfirmation occurs when performance is lower than expected, confirmation occurs when performance matches expectations, and positive disconfirmation arises when performance exceeds expectations. Both confirmation and positive disconfirmation result in satisfaction, whereas negative disconfirmation causes consumer dissatisfaction, affecting both perceived product performance and perceived brand performance (Oliver, 1976; Swan & Trawick, 1981). Indeed, negative disconfirmations resulting from products failing to meet marketer claims have been found to generate negative perceptions of various products within that brand (Darke et al., 2010). Correspondingly, research on product-harm crises already demonstrated that the interplay of expectations and disconfirmation can explain shifts in consumer brand perceptions (Dawar & Pillutla, 2000).

In the context of greenwashing, these effects can be expected primarily because of the heightened expectations arising from the use of green marketing (Horie et al., 2005). When customers form an opinion of a brand, they consider both performance-related aspects and the social responsibility of the respective company (Marín et al., 2016), as well as an ecological perspective (Kinnear & Taylor, 1973). In principle, belief in a brand's environmental performance can support attitudes to that brand (Montoro-Rios et al., 2006). Accordingly, it can be assumed that misleading information at an environmental level counteracts these effects and worsens consumers' brand perceptions. Apart from reduced trust in the brand (Akturan, 2018), greenwashing damages consumers' overall brand equity and, consequently, can even lead to brand avoidance (Xiao et al., 2022).

Although extensive empirical evidence exists on the negative impact of greenwashing on consumer brand perceptions of conventional products (Santos et al., 2023), there is a lack of theoretical and empirical exploration regarding its effects in product innovation contexts. However, considering the characteristics of innovations, we anticipate similar effect patterns for several reasons. First, product innovations often carry higher expectations from consumers regarding their sustainability claims (Aibar-Guzmán & Somohano-Rodríguez, 2021; Dangelico & Pujari, 2010). Innovations, by their nature, are seen as advancements not only in technology but also in ethical and environmental standards (Singh et al., 2023). Furthermore, the introduction of innovations often comes with a premium price (Nejad & Estelami, 2012), justified by the added value of sustainability or technological advancements. Consumers willing to pay this premium expect their purchase to positively contribute to environmental sustainability (Dangelico et al., 2022). Failing to meet these expectations because of greenwashing can result in disappointment and sense of betrayal which can be more pronounced compared to conventional products, where expectations might not be as high or focussed on sustainability aspects. Second, the novelty associated with product innovations means that consumers have less prior experience and fewer benchmarks to judge the product's (sustainability) claims (Wells et al., 2010). Thus, consumers often rely heavily on the information provided by companies to understand and evaluate these products. This reliance makes accurate and honest communication even more critical in the context of innovations. When greenwashing is later revealed, the damage to brand perception can be severe, as the trust that was more blindly placed is harder to rebuild. In conclusion, we hypothesize:

> **H1.** When consumers become aware of revealed greenwashing, this has a negative impact on their brand perception compared to a non-greenwashed sustainable innovation.

Whilst an increasing number of companies are leveraging green positioning to gain competitive advantages (Dangelico, 2016; Hu et al., 2023), there is also a rising incidence of greenwashing being exposed (European Commission, 2021; Sun & Zhang, 2019). Given

the significant negative consequences associated with greenwashing, understanding whether these repercussions outweigh the benefits of refraining from misleading green marketing is crucial. However, current greenwashing research lacks a clear comparison of potential consequences between deceptive marketing practices and products marketed without green attributes (e.g. Chen et al., 2020; Hameed et al., 2021; Xiao et al., 2022). To date, only the results of Nyilasy et al. (2014) indicate that it may be more beneficial for some companies to advertise products without any green claims, rather than risk overstated green claims being exposed and facing negative consequences from a greenwashing scandal. Carried out in the field of advertising in chemical industry, the study suggests that attitudes towards a brand depend on the interaction between the type of advertising messages and the environmental performance of a company. More detailed, the results show that brand perceptions tend to be more favourable for companies that do not disclose their environmental performance and only advertise the brand in general than for companies that engage in greenwashing (Nyilasy et al., 2014). An empirical examination of the transferability of this finding to innovation contexts is still pending. Hence, drawing on these initial results, we hypothesize that:

> **H2.** When consumers become aware of revealed greenwashing, this has a negative impact on their brand perception compared to an innovation without green claims.

2.3 | The mediating role of belief disconfirmation

Beyond the aforementioned hypotheses regarding negative effects of greenwashing, current research is still largely lacking studies uncovering the psychological mechanisms behind these consumer reactions. As laid out before, through the use of green marketing, consumers have heightened expectations of the respective products: they expect global environmental friendliness, health and safety (Horie et al., 2005). These heightened expectations could have serious consequences, particularly in the context of greenwashing, and impact consumer satisfaction (Chen et al., 2019). As indicated by the EDT, unfulfilled expectations perceived by consumers can lead to negative reactions (Oliver, 1976; Swan & Trawick, 1981). Applying the EDT to the context of greenwashing indicates that consumers may experience negative disconfirmation if their sustainability-related beliefs are not met, potentially resulting in dissatisfaction and adverse responses. In addition to heightened sustainability beliefs, a company's social responsibility profile can foster consumer belief that the brand is able to deliver functional benefits (Du et al., 2007). Therefore, besides environmental beliefs, greenwashing can also influence general product perceptions and especially quality beliefs of consumers (Szabo & Webster, 2021). Whilst in the existing greenwashing literature, EDT is repeatedly used rather parenthetically as a basis for explanation, there is a lack of empirical investigations to determine its applicability in terms of psychological mediators rooted in this theoretical framework (Aji & Sutikno, 2015; Chen et al., 2014, 2019; Ha et al., 2022). To fill this gap and in line with the previous discussion that greenwashing may affect both environmental and quality beliefs, we hypothesize that:

> **H3.** When consumers become aware of revealed greenwashing, disconfirmation of (a) sustainability beliefs and (b) quality beliefs mediate the negative effect of greenwashing on brand perception.
>
> **H3a.** Awareness of revealed greenwashing leads to negative disconfirmation of sustainability beliefs, which in turn negatively affects brand perception.
>
> **H3b.** Awareness of revealed greenwashing leads to negative disconfirmation of quality beliefs, which in turn negatively affects brand perception.

2.4 | The moderating role of greenwashing intensity

Whilst the existing literature is characterized by defining greenwashing in terms of sustainability promises not being fulfilled to a certain extent (Delmas & Burbano, 2011; Nguyen et al., 2019), there is a growing interest in a more precise differentiation of distinct forms of greenwashing (De Jong et al., 2020; Lyon & Montgomery, 2015). Traditionally, research has focussed on claim greenwashing, involving misleading textual claims about environmental benefits (Bladt et al., 2023; De Jong et al., 2018), and executional greenwashing, which uses nature-related elements like green imagery (Parguel et al., 2015; Schmuck et al., 2018).

More recent research highlights further differentiation through various specific objectives and communication strategies, including corporate- or firm-level, strategic-level, dark-level (involving illegal activities), and product-level greenwashing (De Freitas Netto et al., 2020; Torelli et al., 2020). Whilst the established differentiation between product- and corporate-level greenwashing shows that greenwashing is particularly serious at the product level (Torelli et al., 2020), potential differences within this category remain largely unexplored.

De Jong et al. (2020) made an initial contribution by including more ambiguous types of greenwashing in their investigation, whereas previous studies primarily examined outright corporate lies. In particular, three different degrees of severity were examined: truth, half-lies and lies. The empirical results showed similar values of reputational damage among the organizations that told only half-lies and those guilty of full greenwashing. Thus, these results suggest that consumers care more about the deception itself than the extent to which the organizational claims and behaviour are inconsistent (De Jong et al., 2020). Conversely, Schmuck et al. (2018) and Bladt et al. (2023) found that vague claims did not increase perceived greenwashing, whereas false claims did, which in turn negatively affected consumers'

attitudes towards the brands. Furthermore, higher levels of perceived deception by consumers were associated with lower credibility of the organization, less positive attitudes towards the advertisement and brand, and reduced intentions to use the advertised product (Newell et al., 1998).

The differentiation between various levels of greenwashing severity—ranging from vague claims to outright lies—highlights the nuanced ways in which consumers can be misled. In the context of product innovations, where new features and benefits are often highlighted as part of the sustainability narrative, the severity of false claims becomes critical. Minor discrepancies from actual sustainability may lead consumers to fill in the gaps with their own optimistic interpretations (Atkinson & Kim, 2014), whereas outright lies can lead to a complete breakdown in trust when the truth comes to light (Bladt et al., 2023). In line with this, initial studies in innovation management suggest that higher levels of 'green product innovation' greenwashing correspond to lower customer satisfaction (Ioannou et al., 2022). This initial finding is also in line with EDT, suggesting that lower levels of greenwashing (minor deviation between claim and fulfilment) should lead to reduced discrepancies between expectations and subsequent beliefs (Anderson, 1973). Consequently, negative disconfirmation should be lower than in the case of high-level greenwashing (major deviation between claim and fulfilment), and consumer reactions may be less negative. In conclusion, different consequences for consumer reactions could be assumed depending on the degree of severity of greenwashing of innovations. We therefore hypothesize that:

> **H4.** When consumers become aware of revealed greenwashing at a high level, this has a greater negative effect on their brand perception than greenwashing at a low level.

2.5 | The moderating role of greenwashing focus

Given the distinction between core and peripheral components of innovative products, as outlined by Goldenberg et al. (1999) and further elaborated by Gatignon et al. (2002) and Ma et al. (2015), it is crucial to consider how greenwashing claims targeting these different components may influence consumer perceptions and responses. Core components, integral to the product's functionality and sustainable value proposition, are particularly vulnerable to greenwashing. Misleading claims targeting these fundamental aspects directly contradict the expected sustainability, potentially leading to pronounced negative reactions from consumers and undermining trust in the brand's overall sustainability.

In contrast, peripheral components, whilst contributing to the product's appeal, do not define its primary sustainable function. Thus, greenwashing claims about these aspects might not elicit as strong a negative response, given their less central role in the product's sustainability. This nuanced distinction in product components underscores the importance of a differentiated approach in assessing the effects of greenwashing. It suggests that the impact can vary significantly depending on whether the misleading claims concern core or peripheral components. This proposition is in line with research by Gershoff and Frels (2015) showing that the centrality of sustainable attributes significantly influences consumer evaluations of product sustainability. This implies that misleading claims about core components are likely to result in more severe negative reactions because of their perceived centrality in the product's innovation and sustainability narrative. To further explore the differential effects of greenwashing based on the targeted product innovation component, the following hypothesis is proposed:

> **H5.** When consumers become aware of revealed greenwashing of the core innovation, this has a greater negative effect on their brand perception than greenwashing of a peripheral component.

3 | STUDY 1

3.1 | Methodological procedures

3.1.1 | Overall research design

Study 1 was designed as a scenario-based experiment to empirically assess the influence of greenwashing on consumers' brand perceptions. To effectively assess the impact of greenwashing in comparison to both non-greenwashed sustainable innovations (H1) and innovations without any green claims (H2), our study design incorporated a between-subjects factor with three distinct treatment groups: sustainable, non-sustainable and revealed greenwashing. This approach allowed us to isolate and compare the effects of greenwashing against both a baseline sustainable innovation and a product marketed without sustainability claims. The research was conducted in the context of the automotive industry, based on a newspaper report about the introduction of an innovative electric car ('MetaTEC'). The automobile industry serves as a suitable context for studying sustainable innovations because consumers are generally aware of the environmental impacts of automobility (Peattie et al., 2009). In addition, simple changes to the environmental impact of a vehicle can be incorporated by replacing the relevant components. The newspaper report was chosen as a third party for the introduction of the car, with information about exposing greenwashing sourced from an independent institute. The report therefore can serve as a reliable accuser, providing evidence of intentional and substantive application of greenwashing practices (Seele & Gatti, 2017).

3.1.2 | Manipulation

The manipulation encompassed three scenarios with varying levels of information about the environmental friendliness of the car. The non-sustainable scenario contained a fact-based message about the

introduction of an innovative electric automobile. In the sustainable and the greenwashing scenarios, the message was expanded to the promise to reduce resource consumption of rare earth metals and conflict raw materials for production by 50%, and thus to represent a revolutionary step towards sustainable electromobility. Previous research has identified the use of sustainability-related messages as a common tool of greenwashing (Baum, 2012; Chen & Chang, 2013; Orazi & Chan, 2020). Thus, sustainability was further manipulated using green annotations: whilst in the non-sustainable scenario the engine and battery were called 'PowerTEC' and 'AkkuTEC', they were labelled 'GreenTEC' and 'BioTEC' in the sustainable and greenwashing scenarios. In the revealed greenwashing scenario, participants received a second newspaper message entitled 'MetaTEC scandal'. This alerted the participants to the fact that the car's rare earth metal savings were not being achieved as stated. Indeed, the resource consumption in the production of the car was similar to that of existing electric automobiles. Detailed scenario descriptions can be found in Appendix A.

3.1.3 | Participants

To ensure the highest standards of ethical conduct, we meticulously adhered to the 'Research Ethics Principles and Review Procedures in the Social and Economic Sciences' (RatSWD [Rat für Sozial- und Wirtschaftsdaten], 2017). This comprehensive framework guided us in maintaining scientific integrity, ensuring the protection of our participants through strict anonymity and confidentiality measures, and securing informed and voluntary consent from all participants involved in all of our studies. For Study 1, a self-administered online questionnaire was used, and the participants were recruited through a German market research institute. The participants were randomly assigned to one of the three scenarios. The questionnaire contained attention check questions to uncover inattentive participants (Abbey & Meloy, 2017). In total, two participants failed to answer the attention check questions correctly, leading to the exclusion from the final sample. As a result, $n = 152$ people ranging from age 18 to 73 were recruited; for details, see Table 1.

3.1.4 | Measurement

Brand perception was measured once using four 7-point semantic difference scales according to Dawar and Pillutla (2000) (after the introduction of the car, in the non-greenwashing scenarios; after the presentation of the newspaper report, in the revealed greenwashing scenario). The participants were asked to indicate their overarching brand perception based on the following attributes: poor/good, negative /positive, not at all reliable/very reliable and not at all trustworthy/very trustworthy. For the purpose of reliability analysis, Cronbach's alpha was calculated. The internal consistency turned out to be excellent for brand perception, giving a Cronbach's alpha > .90, clearly surpassing the threshold of .70 (Gliem & Gliem, 2003).

3.1.5 | Pretest

A pretest ($n = 204$) was conducted that included all scenarios of the following four main studies to check whether the manipulations worked as intended. The participants were randomly assigned to one of the six scenarios (see Table 2).

To check the effectiveness of the manipulations, we assessed perceived product sustainability, credibility and innovativeness using established Likert scales (1 = *strongly disagree*, 7 = *strongly agree*). The scales were adapted from Lee (2020) and Gershoff and Frels (2015) for sustainability, MacKenzie and Lutz (1989) for credibility, and Lee and O'Connor (2003) and Moreau et al. (2001) for innovativeness, all with Cronbach's alpha >.84 (Gliem & Gliem, 2003).

Table 1 shows that the manipulations were successful. The ratings of sustainability differed significantly between scenario 1 (i.e. non-sust) and the rest of the scenarios (i.e. 2-6), $F(1,202) = 8.81$, $p < .01$, indicating scenarios promoting sustainability were perceived as more sustainable than the non-sustainable one. The newspaper message exposing greenwashing led participants to rate those scenarios (i.e. 2, 3, 4) as significantly less credible compared to the scenarios without the scandal (i.e. 1, 5, 6), $F(1,202) = 153.95$, $p < .001$. The electric car 'MetaTEC' was rated as innovative across all groups, with an average score of 5.24.

TABLE 1 Descriptive analyses of samples.

Gender		Education				Income
Male	Female	Vocational training	Graduate degree	High-school diploma	Secondary school certificate	< 35.000 €
Study 1 60.5% (36,5 years)	38.8% (34.5 years)	14.5%	35.5%	35.5%	7.2%	57.2%
Study 2 55.9% (35.1 years)	44.1% (32.7 years)	9.8%	35.3%	37.3%	11.8%	46.1%
Study 3 47.5% (34.4 years)	51.0% (34.9 years)	19.3%	37.1%	32.7%	7.4%	55.0%
Study 4 49.3% (36.5 years)	49.3% (34.2 years)	20.2%	26.6%	40.9%	8.9%	53.2%

TABLE 2 Pretest: results of experimental manipulations.

	Sustainability				Credibility			Innovativeness		
Scenario manipulations	Mean	SD	*f*-value		Mean	SD	*f*-value	Mean	SD	*f*-value
1. Non-sust (*N* = 33)	4.38	1.32	8,81*	Pre	5.17	1.37	153.949**	5.07	1.17	1.00
2. GW (*N* = 35)	5.30	1.04		Post	2.79	1.21		5.39	0.85	
3. Low-level GW (*N* = 31)	5.24	0.99		Post	3.33	1.32		5.40	1.02	
4. High-level GW (*N* = 38)	5.35	1.26		Post	2.90	1.66		5.37	1.13	
5. MinorC GW (*N* = 35)	5.06	1.07		Pre	5.54	1.15		5.22	0.99	
6. CoreInno GW (*N* = 32)	4.93	1.25		Pre	5.35	1.42		4.95	1.08	

*Significant at $p < .01$.
**Significant at $p < .001$.

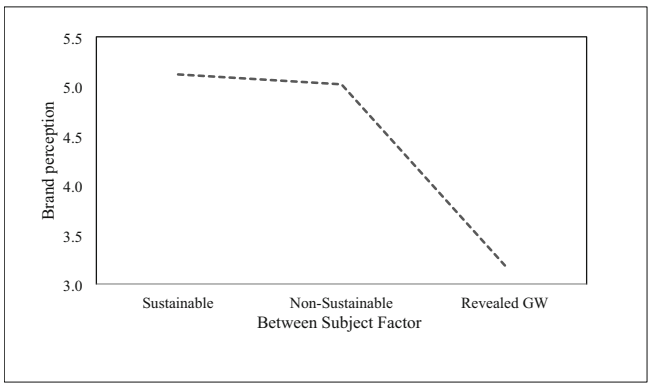

FIGURE 1 Mean comparison of brand perception in sustainable, non-sustainable and greenwashing scenarios.

Additionally, we used four 7-point Likert scale items to check the realism of the scenarios (Dabholkar & Bagozzi, 2002) and one item ('This product is totally new to me') to ensure the participants were unfamiliar with the product (Heidenreich et al., 2016). Both checks were successful, with high average scores for realism (5.44) and familiarity (6.28).

3.2 | Results

Because relatively large groups with similar sample sizes were generated ($n_{Sustainable} = 49$; $n_{Non\text{-}Sustainable} = 52$; $n_{RevealedGW} = 51$), analysis of variance (ANOVA) can be used as a robust method for analysis (Blanca Mena et al., 2017). Thus, differences in consumer reactions were examined by conducting a one-way ANOVA with the group condition used as a between-subjects factor. Levene's test was used to check the model assumption of variance homogeneity, which could be confirmed ($p = .341$). In summary, the results empirically support H1 and H2, as depicted in Figure 1. They reveal statistically significant differences in brand perceptions across scenarios, $F(2, 149) = 36.72$, $p < .001$, highlighting greenwashing's negative impact on brand perception. Tukey post-hoc analysis indicated significantly lower brand perception in the revealed greenwashing scenario compared to both the sustainable innovation without a greenwashing scandal (−1.93, 95% CI[−2.54, −1.33]) and the non-sustainable innovation (−1.83, 95% CI[−2.43, −1.23]). Revealed greenwashing leads to significantly poorer brand perception ($M_{RevealedGW} = 3.19$, $SD = 1.48$) than when consumers believe in the product's sustainability ($M_{Sustainable} = 5.12$, $SD = 1.18$), confirming H1. Moreover, brand perception in the revealed greenwashing group is notably worse compared to the non-sustainable scenario, where no sustainable aspects were communicated ($M_{Non\text{-}Sustainable} = 5.02$, $SD = 1.14$). Thus, revealing greenwashing results in more negative brand perception than for products marketed without explicitly advertised green attributes, supporting H2.

4 | STUDY 2

4.1 | Methodological procedures

4.1.1 | Overall research design

Study 2 aims to examine the effect of revealed greenwashing on consumers sustainability (H3a) and quality beliefs (H3b). Additionally, we aim to demonstrate that disconfirmations of these beliefs mediate the relationship between revealed greenwashing and consumers brand perceptions (H3). Therefore, Study 2 was designed as a scenario-based experiment with greenwashing as a between-subjects factor with two treatment groups (confirmed sustainability vs. revealed greenwashing). The research context mirrors Study 1, set in the automotive industry and utilizing the introduction of an innovative electric car 'MetaTEC'.

4.1.2 | Manipulation

The manipulations followed the first study's format. The participants were introduced to the innovative electric car 'MetaTEC', promoted as a revolutionary step towards sustainable electromobility, with a promise of reducing resource consumption by 50%. To capture the potential differences in outcomes if green objectives are fulfilled

versus not fulfilled, both experimental groups received a second newspaper message. The 'confirmed sustainability' group received a message confirming the reduced resource consumption promise. The 'revealed greenwash' group received news of the 'MetaTEC scandal' used in Study 1. Scenario descriptions are in Appendix A.

4.1.3 | Participants

We employed a self-administered online questionnaire and collaborated with a German market research agency for participant recruitment. In this way, after excluding five participants who did not pass the attention checks, the final sample included 102 participants aged between 18 and 73 (see Table 1).

4.1.4 | Measurement

For measuring brand perception, we used the same operationalization as in Study 1 (Dawar & Pillutla, 2000). To examine the underlying psychological processes based on EDT, disconfirmation was calculated by the difference between pre- and post-ratings of beliefs, following Heidenreich et al. (2015). Items were contextualized for quality beliefs ('If I were to purchase the MetaTEC electric vehicle, I would own an excellent/high-quality/highly reliable/very good car') and for sustainability beliefs ('If I were to purchase the MetaTEC electric vehicle, I would own a sustainable/ecological/environmentally friendly/green car'). The internal consistency of the scales is satisfying, with a Cronbach's alpha of > .90 (Gliem & Gliem, 2003).

4.2 | Results

First, we examined the effect of greenwashing on the disconfirmation of sustainability beliefs. A repeated measures ANOVA showed a significant interaction between pre- and post-measurement of sustainability beliefs and the greenwashing versus confirmed sustainability condition, $F(1,100) = 59.33$, $p < .001$. In the greenwashing group, beliefs in overall sustainability decreased significantly from $M_{RevealedGW\_Pre} = 4.92$ to $M_{RevealedGW\_Post} = 3.09$ after the revealing message, $F(1,52) = 58.75$, $p < .001$. This effect was not present in the control group with confirmed sustainability, $F(1,48) = .133$, $p = .717$. These results support H3a, confirming negative disconfirmation of sustainability beliefs in the case of revealed greenwashing.

We also investigated the effects of revealed greenwashing on the disconfirmation of quality beliefs. Repeated measures ANOVA showed a significant interaction between measurement points of quality beliefs and greenwashing conditions, $F(1,100) = 24.91$, $p < .001$. In the greenwashing group, expectations of overall quality decreased significantly from $M_{RevealedGW\_Pre} = 5.02$ to $M_{RevealedGW\_Post} = 3.84$, indicating negative disconfirmation, $F(1,52) = 34.31$, $p < .001$. No differences in quality perceptions were found in the control group, $F(1,48) = .002$, $p = .97$, supporting H3b.

With H3a and H3b accepted, we investigated both types of disconfirmation as potential mediators using parallel mediation analyses with PROCESS by Hayes (2018). Bootstrapping with 10,000 iterations was used to calculate confidence intervals and inferential statistics. Confirmed sustainability versus revealed greenwashing was the independent variable, disconfirmation of sustainability and quality beliefs were the mediators, and post-enquiry brand perception was the dependent variable. We followed Baron and Kenny's (1986) approach to test for mediation.

First, we examined the direct effect of greenwashing on brand perception, showing a significant negative impact ($\beta = -2.16$, $p < .001$), supporting H1. When adding the mediators, both disconfirmation of sustainability beliefs (−0.31, 95% CI[−0.5846, −0.0681]) and quality beliefs (−0.24, 95% CI[−0.4285, −0.0692]) showed significant indirect effects. The total indirect effect of the mediators was −0.55, 95% CI[−0.7949, −0.3214], supporting H4. The direct relationship still showed significant influence, indicating partial mediation ($p = .004$). A comparison of the indirect effects showed no significant difference (95% CI [−0.4666, 0.2934]). See Figure 2 for individual path analysis.

5 | STUDY 3

5.1 | Methodological procedures

5.1.1 | Overall research design

Study 3 aims to investigate the impact of revealed greenwashing on consumers' brand perception, considering the level of greenwashing as proposed in H5. Similar to Studies 1 and 2, we conducted a scenario-based experiment in the context of electromobility. The study was constructed as a 2 (existence of greenwashing: confirmed sustainability vs. revealed greenwashing) × 2 (level of greenwashing: low vs. high) between-subjects design. Low-level greenwashing involves low deviations between the green promises and their fulfilment, whereas high-level greenwashing signifies substantial discrepancies in this context.

5.1.2 | Manipulation

The manipulation comprised the following four scenarios. In the low-level condition, the electric car was touted as a respectable step toward sustainable electromobility, reducing the resource consumption of rare earth metals and conflict raw materials by 50%. In contrast, the high-level greenwashing condition touted the car as a revolutionary step toward sustainable electromobility, promising an 85% reduction in resource consumption. In the second newspaper message, which revealed the actual performance of the automobile, the scenarios differed as follows: the confirmed sustainability group received the 'study on MetaTEC', confirming the resource reductions of 50% and 85%, respectively. The greenwashing condition received

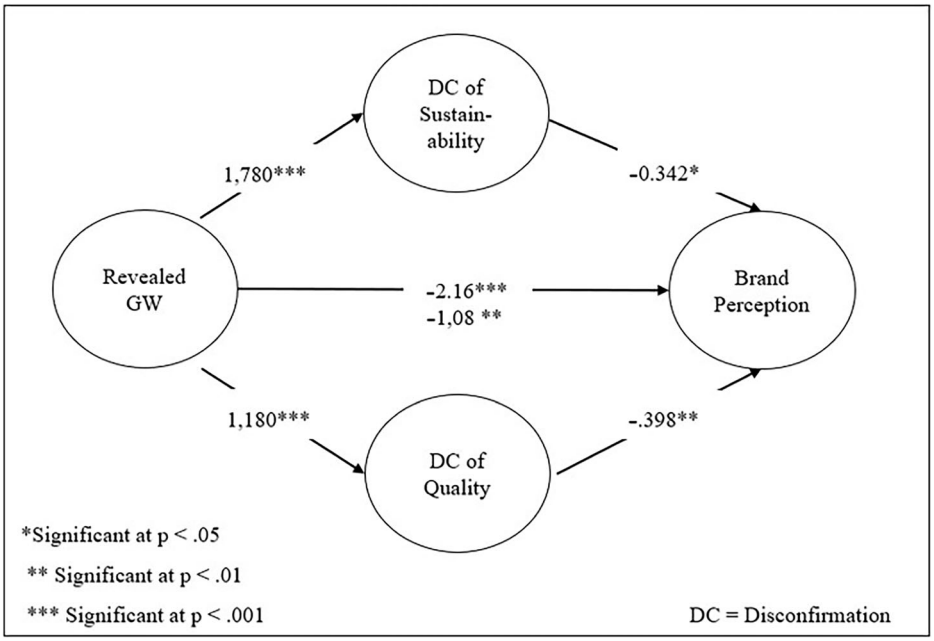

FIGURE 2 The mediating effect of disconfirmation on the relationship between greenwashing and brand perception.

the revealing article 'MetaTEC scandal'. In the low-level scenario (greenwashing), it is reported that the promises are not completely fulfilled and that the resource consumption in the production of the MetaTEC electric vehicle is not reduced by 50% as claimed by the manufacturer but only by 40% on average. In the high-level scenario (greenwashing), it is revealed that resource consumption is reduced by only 10% instead of 85%, which thus represents a much more extreme failure to fulfil the promises. A detailed description of the scenarios can be found in Appendix A.

5.1.3 | Participants

The participants were acquired through a German market research institute and completed a self-administered online questionnaire. The final sample, adjusted for 10 participants who did not pass the attention check, consisted of 202 participants aged between 18 and 84 (see Table 1).

5.1.4 | Measurement

The participants were asked to indicate their perceptions of the brand on 7-point semantic differential scales, operationalized as already presented in Studies 1 and 2 (Dawar & Pillutla, 2000).

5.2 | Results

ANOVA with repeated measures was used to investigate the proposed effects, as it is robust with relatively equal and sufficient group sizes ($N_{ConfiSustainable\_MIN} = 50$, $N_{ConfiSustainable\_MAX} = 52$, $N_{RevealedGW\_MIN} = 52$, $N_{RevealedGW\_MAX} = 48$) (Tavakoli, 2012). The pre- and post-measurements served as within-subject factors, whilst the conditions (greenwashing vs. confirmed sustainability) and the levels of greenwashing (high vs. low) were defined as between-subjects factors. H4 assumes that brand perception is more negatively affected by greenwashing with substantial discrepancies between promises and actual fulfilment compared to greenwashing with only minor deviations from sustainable promises. The analysis revealed a significant interaction effect of the time of measurement, the greenwashing condition and the extent of greenwashing on overall brand perception ($F[1,198] = 20.11$, $p < .001$). Specifically, within the greenwashing group, there was a significant interaction effect of measurement time and severity of greenwashing ($F[1,98] = 22.08$, $p < .001$).

To rule out pre-measurement differences within the greenwashing groups, a comparison of mean values showed no significant differences in brand perception before the revealing message ($p = .358$).

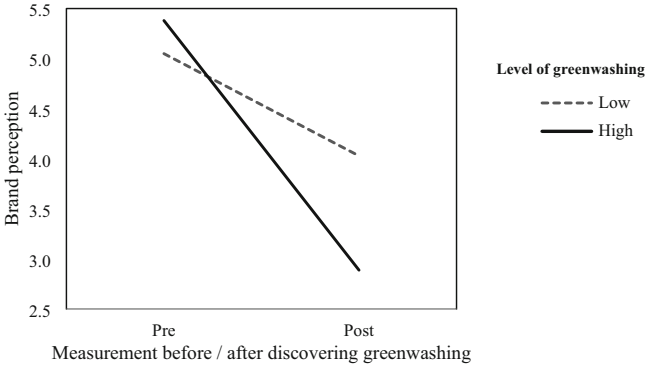

FIGURE 3 Interaction effect between the discovery of greenwashing and the level of greenwashing on consumers' brand perception.

Accordingly, the effect of detecting greenwashing at a high level ($M_{RevealedGW\_MAXPost} = 2.89$) has a greater negative impact on consumers' brand perception than the effect of detecting low levels of greenwashing ($M_{RevealedGW\_MINPost} = 4.03$), supporting H4.

In addition, a significant main effect of the pre–post evaluation was found ($F[1,98] = 137.85$, $p < .001$), showing that the detection of greenwashing, regardless of the level, generally degrades the perception of the brand. Further analysis using a paired *t*-test for the low-level greenwashing scenario showed a significant decrease in brand perception after exposure ($t[51] = 6.53$, $p < .001$). As illustrated in Figure 3, whilst high levels of greenwashing exhibit a more pronounced negative effect, even minor discrepancies between sustainability promises and fulfilment significantly deteriorate brand perception ($M_{RevealedGW\_MINPre} = 5.05$; $M_{RevealedGW\_MINPost} = 4.03$).

6 | STUDY 4

6.1 | Methodological procedures

6.1.1 | Overall research design

Study 4 aims to investigate fundamental differences in consumer reactions, depending on whether greenwashing occurs with a focus on the core innovation or relates to a minor component of the innovation, by empirically testing H5. The study is placed in the same research context (innovative electric car) as the previous studies and was designed as a 2 (existence of greenwashing: confirmed sustainability vs. greenwashing) × 2 (greenwashing focus: peripheral component vs. core innovation) between-subjects experimental design.

6.1.2 | Manipulation

Manipulations followed the procedure of the previous studies. First, the participants received the newspaper report about the introduction of the innovative electric car 'MetaTEC', which reduces resource consumption by 50%. In the case of the greenwashing condition, the participants were then confronted with the 'MetaTEC scandal', which revealed that the targets would not be met and that resource consumption was comparable to that of existing electric vehicles. In the case of confirmed sustainability, the participants received the 'study on MetaTEC', which confirmed that the targeted green claims were achieved. In order to examine the difference between the impact of greenwashing of the core innovation versus that of a peripheral component, the resource consumption targets in the innovation condition are related to the innovation as a whole. Thus, the overall resource consumption of rare earth metals and conflict raw materials was to be reduced by 50% in the production of the electric car. In the case of the greenwashing of the peripheral component, in contrast, the targets were related exclusively to the production of the body construction. In the pretest conducted (see Section 3), a further control question was integrated for the scenarios of Study 4 to check whether the participants sufficiently perceived the focus on the body construction component. Accordingly, the participants had to indicate their agreement with the statement 'Savings in rare earth metals and conflict raw materials are achieved through the use of new composite materials in body construction' on a 7-point Likert scale from '*strongly disagree*' (1) to '*strongly agree*' (7). Because of the high average value ($M_{Comp} = 5.51$), it is assumed that the manipulation of the component focus worked as intended.

6.1.3 | Participants

The data were acquired by means of an online questionnaire administered by a German market research institute. Checking through the attention questions resulted in the exclusion of 21 participants, leading to a final sample of 203 participants, aged between 18 and 74 (see Table 1).

6.1.4 | Measurement

All the experimental groups were questioned repeatedly about their assessments of the electric car, both before and after the second report about compliance or non-compliance with the green claims. The operationalization of the dependent variable, brand perception, utilized the scale previously introduced in the preceding studies (Dawar & Pillutla, 2000).

6.2 | Results

With relatively large and equal group sizes, repeated measures ANOVA was used as a robust procedure for data analysis ($N_{ConfiSustsainable\_Minor} = 52$, $N_{ConfiSustainable\_Inno} = 52$, $N_{RevealedGW\_Minor} = 47$, $N_{RevealedGW\_Inno} = 52$) (Tavakoli, 2012). The analyses focussed on the interactions between the within-subject variables, that is, the measurement before and after the second newspaper report, and the between-subjects variables, that is, the group condition and the greenwashing focus condition.

H5 assumes that greenwashing focussing on the core innovation damages consumers' brand perception more than greenwashing of a peripheral component. Whilst the three-way interaction was not significant ($F[1,199] = 3.5$, $p = .063$), there was a significant difference between the greenwashing and confirmed sustainability groups ($F[1,199] = 45.2$, $p < .001$), as indicated by the test of between-subject effects. In the greenwashing group, it was confirmed that greenwashing of the core innovation versus a peripheral component had different impacts on brand perception ($F[1,97] = 5.24$, $p < .05$). As illustrated in Figure 4, brand perception deteriorates to a greater extent when the entire innovation is affected ($M_{RevealedGW\_INNOpost} = 3.27$, $M_{RevealedGW\_MINORpost} = 3.57$). Furthermore, a significant main effect of pre–post evaluation was observed, ($F[1,97] = 150.76$, $p < .001$), reinforcing that detection of

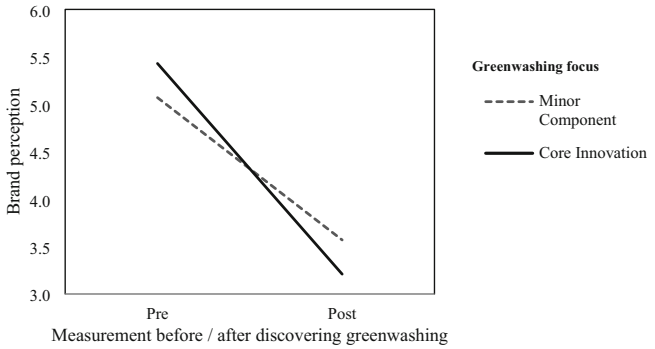

FIGURE 4 Interaction effect between the discovery of greenwashing and the focus of greenwashing on consumers' brand perception.

greenwashing generally worsens brand perception. To further analyse whether greenwashing of peripheral components significantly worsens brand perception, we conducted a paired *t*-test. The peripheral component greenwashing group showed a significant decline in brand perception after exposure to green deception ($t[46] = 6.86$, $p < .001$), underscoring the adverse effects of greenwashing on brand reputation, even for less central components.

7 | DISCUSSION

The present research aims to advance existing knowledge in the field of greenwashing of innovations by examining its potential consequences on brand perceptions by answering the aforementioned four research questions. Consistent with prior research (Akturan, 2018; Chen et al., 2016; Szabo & Webster, 2021), our findings from Study 1 aimed at answering research question 1 replicate that inaccurate information regarding the sustainability of a product can cause negative brand perceptions also in innovation contexts. Study 1 extends previous findings on this matter, by simultaneously exploring these outcomes in comparison to consumers exposed to a green product without deception and also to innovations not explicitly marketed as environmentally friendly. Our results align with Nyilasy et al. (2014), suggesting that it might be more advantageous for companies to abstain from incorporating (false) sustainability aspects. Rather, non-sustainable innovations should be marketed without artificially assigned green attributes.

Moving to Study 2, which addressed our second research question, our results show that the EDT (Oliver, 1976) provides a robust theoretical foundation for understanding the psychological processes behind consumer judgements related to revealed greenwashing. When consumers experience a discrepancy between the advertised sustainability of an innovation and its fulfilment, imbalances in their beliefs of sustainability and quality against their expectations emerge. Interestingly, greenwashing not only affects sustainability aspects but also impacts the overall perception of product quality. The negative disconfirmations of sustainability and quality beliefs mediate the negative effect of greenwashing on brand perceptions. This aligns with previous research that highlights the significant role of expectation disconfirmation in consumer evaluations (Aji & Sutikno, 2015; Chen et al., 2014).

Addressing our third research question, Study 3 investigates varying levels of greenwashing, confirming the general assumption that uncovering greenwashing elicits negative consumer reactions. Moreover, these reactions vary based on the degree of discrepancy between stated sustainability goals and actual compliance. High-level greenwashing, characterized by significant gaps between green targets and compliance, results in more pronounced damage to consumer perceptions of the brand compared to low-level greenwashing. Nonetheless, it is crucial to recognize that even minor instances of greenwashing can substantially harm brand perception. These findings provide empirical support for the notion that the severity of greenwashing impacts consumer responses differently (Lyon & Maxwell, 2011; Yang et al., 2020).

In the course of a deeper differentiation of greenwashing practices (Lyon & Maxwell, 2011; Yang et al., 2020), Study 4 addresses research question 4 by distinguishing between the greenwashing of the core innovation and greenwashing of a peripheral component. Thereby, evidence was found indicating that it is indeed of significance whether the entire product or only a peripheral part of it gets greenwashed. In particular, the results suggest that consumers' brand perceptions shift to different degrees depending on whether the core component or a minor component of the innovation is affected. More specifically, greenwashing that affects the innovation as a whole has a more negative impact on attitude towards the brand. These findings align with existing research on the centrality of attributes in the perception of sustainability in products (Gershoff & Frels, 2015) and extend them to the context of greenwashing. However, our results emphasize once more that even embellishing minor components with green attributes significantly harms brand perception when exposed as not being adhered to.

8 | THEORETICAL IMPLICATIONS

Whilst the introduction of green innovations has become essential for organizations (Ioannou et al., 2022; Zhang, 2023), the resulting increase in feigned sustainability (Liu et al., 2023)—known as greenwashing—calls for further empirical investigations. Drawing on the theoretical foundation of EDT and the empirical findings from four scenario-based experiments, this research elucidates the nuanced dynamics between greenwashing practices and consumer brand perception in the realm of sustainable innovations. Hence, this study offers important contributions to the research field of innovation management and marketing.

First, this study provides empirical evidence that consumers' brand perceptions deteriorate significantly upon disillusionment by fake sustainability claims within the context of product innovations. By extending existing findings from conventional products (Bladt et al., 2023; Schmuck et al., 2018) to product innovations, this

research delivers crucial empirical evidence that the negative causal effect patterns associated with greenwashing are equally applicable to product innovations. This revelation is particularly pertinent as product innovations, by their very nature, are often vested with heightened consumer expectations regarding their sustainability credentials (De Medeiros et al., 2014). Moreover, the findings enrich prior research by providing a comparative analysis between sustainable innovations affected by greenwashing scandals and scenarios where products are not marketed with particular emphasis on their green attributes. This comparative approach unveils a nuanced understanding of greenwashing's impact, revealing that misleading sustainability associations can inflict more significant damage on brand perception than if sustainability claims were altogether absent. This distinction is critical in the innovation context, where the novelty and perceived value of the product are closely tied to its sustainability features.

Second, our study enriches the theoretical landscape by investigating the psychological processes behind consumer judgments in the face of greenwashing. The negative impact of greenwashing on brand perception is significantly mediated by the disconfirmation of both sustainability and quality beliefs. Aligning with the core principles of EDT, our findings provide empirical evidence that these negative effects stem from the disconfirmation of consumer expectations regarding sustainability and quality. This research supports embedding EDT within greenwashing studies, a connection previously speculated upon but not comprehensively demonstrated (Aji & Sutikno, 2015; Chen et al., 2014, 2019; Ha et al., 2022). By showing the disconfirmation of both sustainability and quality beliefs, our study offers a detailed understanding of consumer reactions to greenwashing. It reveals that unfulfilled green promises affect not only perceptions of a product's environmental credentials but also its overall quality, even without objective quality deterioration. This dual disconfirmation model extends the application of EDT, suggesting that greenwashing impacts both environmental and broader product quality perceptions. This finding also provides preliminary insights into the relatively underexplored impact of greenwashing on product-related characteristics (Chen et al., 2014; Szabo & Webster, 2021).

Third, our findings significantly advance the discourse on greenwashing by offering a nuanced differentiation of its forms and intensities. Responding to calls for deeper investigation into various manifestations of greenwashing (Bladt et al., 2023; De Jong et al., 2020; Lyon & Maxwell, 2011), this research examines distinctions within 'greenwashing at the product level' (De Freitas Netto et al., 2020). Using established classification approaches (Bladt et al., 2023; Schmuck et al., 2018; Torelli et al., 2020), we investigate the negative effects of greenwashing based on its severity (Study 3) and focus (Study 4), enriching the theoretical understanding of its multifaceted nature. This differentiation is crucial, as it shows that not all greenwashing is perceived equally by consumers. The empirical findings reveal that varying degrees of deviation from genuine sustainability claims, ranging from slight exaggerations to outright falsehoods, can have significantly different effects on brand perception. Similarly, the focus of greenwashing, whether it targets core or peripheral aspects of a product innovation, influences consumer reactions in distinct ways. These insights move the understanding of greenwashing beyond a unidimensional construct, highlighting its complexity and varied nature. A multifaceted understanding of greenwashing aligns with the evolving theoretical landscape, which seeks a more granular and differentiated approach (Bladt et al., 2023; Yang et al., 2020). Recognizing the nuanced effects of different greenwashing strategies allows future research to employ a theoretical framework that accommodates the complexity of greenwashing practices in the modern marketplace.

9 | MANAGERIAL IMPLICATIONS

The findings from this study offer significant implications for managers and practitioners, particularly those involved in sustainability marketing and innovation management. Whilst introducing new sustainable products offers an opportunity to enhance a company's reputation and brand image (De Brentani et al., 2010), it must be approached with caution because of the inherent risks to brand perception associated with greenwashing. Such negative perceptions fundamentally threaten the successful diffusion of new products (Corkindale & Belder, 2009), highlighting the importance of avoiding greenwashing to prevent considerable brand damage. Understanding the nuanced effects of greenwashing, not only in terms of severity but also concerning the focus of misleading claims, provides valuable insights for developing more ethical and effective marketing strategies.

First, this research highlights how the severity of greenwashing influences consumer reactions. With market and political pressures compelling companies to innovate sustainably (Tuffour et al., 2023; Zhang, 2022), particularly egregious misleading claims can have dire consequences. Managers should avoid significant exaggerations in sustainability claims. The closer a product's promoted sustainability aligns with its actual characteristics, the less likely consumers are to react negatively if discrepancies are uncovered. Our findings show that revealed greenwashing elicits significantly more negative reactions than marketing a product without emphasizing its sustainable attributes. This aligns with social innovation research, which stresses the importance of companies demonstrating their commitment to social responsibility (Sigurdsson & Candi, 2020). Whilst sustainable product features and a green corporate image can offer benefits (Dangelico & Vocalelli, 2017) and enhance environmental legitimacy (Berrone et al., 2017), transparency and honesty in sustainability claims are paramount.

Second, the differentiation between core and peripheral greenwashing underscores the need for strategic communication of sustainability efforts. Managers should prioritize authenticity in claims related to the core value proposition of sustainable innovations, as misleading information in these areas significantly harms brand perception. This calls for a careful review of marketing messages to ensure they accurately reflect the product's environmental benefits without overstatement. This involves not only making verifiable claims but also being open about the challenges and limitations of their

environmental initiatives. Providing consumers with clear, comprehensive information about the sustainability aspects of the core innovation can help build a more trustworthy relationship and encourage informed purchasing decisions.

Third, the application of EDT as an explanatory framework for consumer reactions further suggests that organizations should actively seek validation for their sustainability claims. Meeting consumer expectations can lead to confirmation and satisfaction (Oliver, 1997). Leveraging government-approved labels, audits and reports from independent third parties can substantiate the sustainability of an innovation with credible evidence. This approach is increasingly vital as the demand for transparency and standardized audit criteria grows in response to the prevalence of greenwashing (Laufer, 2003; Parguel et al., 2011). As consumer awareness and expectations evolve, so too should the approaches companies take to communicate their sustainability efforts (Cherry, 2012). This involves staying informed about emerging trends and regulatory changes in environmental marketing, as well as being responsive to consumer feedback and concerns regarding sustainability claims.

10 | LIMITATIONS AND FUTURE RESEARCH

As with almost any research, some limitations should be kept in mind when interpreting the presented results. First, all four studies focussed on electric cars as research objects. Whilst the automobile industry is widely considered to be a prime example of relevant sustainable change in products (Peattie et al., 2009) and practical greenwashing cases are already reported in this field (Forbes, 2015; Pimonenko et al., 2020), the focus on this specific industry limits generalizability to other contexts. Furthermore, the existing literature on green marketing highlights that consumers' attitudes towards green products are significantly influenced by their level of product involvement (Atkinson & Rosenthal, 2014; Coşkun et al., 2017; Nagar, 2015). This variance in consumer engagement and interest underscores the complexity of green product marketing and suggests that the effectiveness of green claims may not be uniform across different product categories. In particular, it would be interesting to investigate whether the present results differ for other product innovations, for instance, in the field of durables.

Second, the studies' reliance on participants recruited solely from Germany raises questions about the universality of the findings. More specifically, the propensity to detect greenwashing and subsequent consumer reactions may vary across cultural contexts (Schmuck et al., 2018). Therefore, extending this research to a broader range of geographical settings is crucial to validate the global applicability of the results.

Third, this research highlights that greenwashing, even at minimal levels where sustainability claims marginally diverge from reality, can negatively impact consumer perceptions. However, the exploration of specific thresholds at which the effects of greenwashing become significantly detrimental to human perception has not been addressed. Utilizing greenwashing as a continuous variable and methodically varying and measuring its intensities in experimental designs could enable a more detailed examination. Such an approach would allow future research to pinpoint the precise level of deception at which greenwashing begins to exert a pronounced and negative influence on consumer perceptions. This investigation could provide critical insights for both academics and practitioners, offering a clearer understanding of how varying degrees of greenwashing affect consumer trust and brand loyalty.

Forth, further investigation into the attributes targeted by greenwashing is needed for a more comprehensive understanding. Our findings indicate that greenwashing less critical components might lead to milder consequences, yet the overarching negative impact of greenwashing remains undeniable. Hence, future research may investigate recovery strategies that can be applied after greenwashing has come to light. Because green targets are often used without being pursued (Kolcava, 2023), it is important to determine which restorative measures could mitigate the negative consumer reactions observed in this study.

Fifth, scenario-based experiments, although effective in simulating real-world situations in a controlled environment (Charness et al., 2012; Heidenreich et al., 2022), may not fully capture the complexity and unpredictability of actual consumer behaviour. The hypothetical nature of scenarios might limit the external validity of our findings, as participants' responses could differ from their actions in real-life situations. Future research should replicate and validate our findings using real-world data, such as longitudinal studies tracking consumer reactions to actual greenwashing instances or surveys capturing perceptions before and after greenwashing scandals become public. Such studies would not only enhance the external validity of our findings but also provide deeper insights into the dynamics of consumer behaviour in natural greenwashing settings.

Finally, future research should aim to establish a comprehensive conceptual framework for understanding greenwashing as a multidimensional construct. Initial literature reviews have started to outline the concept of greenwashing (Seele & Gatti, 2017; Yang et al., 2020), but its complexity deepens as research delves into diverse greenwashing typologies (De Jong et al., 2020; Nyilasy et al., 2014; Schmuck et al., 2018; Torelli et al., 2020). Developing a fundamental classification system is crucial for attaining a unified and in-depth comprehension of greenwashing.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT and DeepL Write in order to improve language and readability. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

ACKNOWLEDGEMENTS

Open Access funding enabled and organized by Projekt DEAL. [Correction added on 31 March 2025, after first online publication: Projekt DEAL funding statement has been added.]

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to cite this article: Janz, F., Jordanow, S., Heidenreich, S., & Schäfer, J. (2025). Shades of green deception—An empirical examination into the consequences of greenwashing of innovations. *Creativity and Innovation Management*, *34*(2), 312–332. https://doi.org/10.1111/caim.12639

APPENDIX A

The specifications of the MetaTEC electric car are consistent across all studies. Please insert(*) at the appropriate place.

* The detailed specifications of the METAtec electric vehicle are provided below:

Motorization: Electric motor with asynchronous machine.

Range: 1100 km.

Autonomous driving: Yes (autopilot assistance system).

Engine power: 480 to 550 hp.

Acceleration 0–100 km/h: 3.5 to 4.5 s.

Top speed: 230 to 250 km/h.

Dimensions: 4801 mm L × 1945 mm W × 1478 mm H.

Vehicle weight: 2150 to 2250 kg.

Scenario description Studies 1 and 2

Non-Sustainable Innovation (Study 1):

Innovative METAtec electric vehicle:

The car manufacturer META is developing an innovative electric vehicle METAtec with a planned market launch in 2022. The propulsion system features an innovative electric drive using an asynchronous machine called PowerTEC. In addition, a new type of lithium-ion battery called AkkuTEC will be installed as a power storage unit. *.

Sustainable Innovation (Study 1), Revealed Greenwashing (Study 1 and Study 2, 1/2) and Confirmed Sustainability (Study 2, 1/2):

Innovative and sustainable electric vehicle METAtec:

The car manufacturer META is developing an innovative electric vehicle METAtec with a planned market launch in 2022. According to the manufacturer, METAtec represents a revolutionary step towards sustainable electromobility. The propulsion system features an innovative electric drive using an asynchronous machine called GreenTEC. Components made of composite materials, such as carbon fibre-reinforced plastics, are to be used in this drive system. In an effort to preserve scarce resources, the engineers intend to avoid using depleting raw materials like rare earth metals. Additionally, a cobalt-free battery called BioTEC is employed, containing fewer conflict materials. Overall, this reduces the consumption of rare earth metals and conflict raw materials by 50%. *.

Confirmed Sustainability (Study 2, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper.

Study on METAtec

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a revolutionary step towards sustainable electromobility.

As revealed by an independent study conducted by the MAFIN Institute, the electric drive with an asynchronous machine named GreenTEC does indeed save depleting resources such as yttrium and neodymium, as claimed by the manufacturer. Similarly, the news about savings in conflict minerals in the used cobalt-free lithium-ion battery named BioTEC has been confirmed. It has been disclosed that the new lithium-ion battery significantly saves cobalt.

According to a study by the independent institute MAFIN, the overall consumption of rare earth metals and conflict raw materials in the production of the METAtec electric vehicle is indeed reduced by 50%, as claimed by the manufacturer.

Revealed Greenwashing (Study 1 and Study 2, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

METAtec scandal

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a revolutionary step towards sustainable electromobility. However, it has now been revealed that, despite the savings in depleting resources such as yttrium and neodymium through the electric drive with an asynchronous machine named GreenTEC, there is an increase in the demand for other rare earth metals like terbium, praseodymium and dysprosium. The report on the saving of conflict raw materials in the cobalt-free lithium-ion battery called BioTEC is equally misleading. As it turns out, the new lithium-ion battery saves a significant amount of cobalt, but at the same time increases the demand for other conflict raw materials such as nickel.

According to a study by the independent institute MAFIN, the overall resource consumption of rare earth metals and conflict raw materials in the production of the METAtec electric vehicle is not reduced by 50% as claimed by the manufacturer. Instead, when considering all the consumed rare earth metals and conflict minerals, it averages similarly high as in existing electric vehicles.

Scenario description Study 3

Confirmed Sustainability Low Level (Study 3, 1/2), Revealed Greenwashing Low Level (Study 3, 1/2):

Innovative and sustainable electric vehicle METAtec

The car manufacturer META is developing an innovative electric vehicle METAtec with a planned market launch in 2022. According to the manufacturer, METAtec represents a *respectable* step towards sustainable electromobility. The propulsion system features an innovative electric drive using an asynchronous machine called GreenTEC. Components made of composite materials, such as carbon fibre-reinforced plastics, are to be used in this drive system. In an effort to preserve scarce resources, the engineers intend to avoid using depleting raw materials like rare earth metals. Additionally, a cobalt-free battery called BioTEC is employed, containing fewer conflict materials. *Overall, this will reduce the consumption of rare earth metals and conflict raw materials by 50%. *.*

Confirmed Sustainability Low Level (Study 3, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

Study on METAtec

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a *respectable* step towards sustainable electromobility.

As revealed by an independent study conducted by the MAFIN Institute, the electric drive with an asynchronous machine named GreenTEC does indeed save depleting resources such as yttrium and

neodymium, as claimed by the manufacturer. Similarly, the news about savings in conflict minerals in the used cobalt-free lithium-ion battery named BioTEC has been confirmed. It has been disclosed that the new lithium-ion battery significantly saves cobalt.

According to a study by the independent institute MAFIN, the overall consumption of rare earth metals and conflict raw materials in the production of the METAtec electric vehicle *is indeed reduced by 50%, as stated by the manufacturer*.

Revealed Greenwashing Low Level (Study 3, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

METAtec scandal

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a *respectable* step towards sustainable electromobility.

However, it has now been revealed that, despite the savings in depleting resources such as yttrium and neodymium through the electric drive with an asynchronous machine named GreenTEC, there is an increase in the demand for other rare earth metals like terbium, praseodymium and dysprosium. The report on the saving of conflict raw materials in the cobalt-free lithium-ion battery called BioTEC is equally misleading. As it turns out, the new lithium-ion battery saves a significant amount of cobalt but at the same time increases the demand for other conflict raw materials such as nickel.

According to a study by the independent institute MAFIN, the overall resource consumption of rare earth metals and conflict raw materials in the production of the METAtec electric vehicle *is not reduced by 50%* as claimed by the manufacturer. Instead, when considering all the consumed rare earth metals and conflict minerals, *the average reduction is only 40%*.

Confirmed Sustainability High Level (Study 3, 1/2), Revealed Greenwashing High Level (Study 3, 1/2):

Innovative and sustainable electric vehicle METAtec

The car manufacturer META is developing an innovative electric vehicle METAtec with a planned market launch in 2022. According to the manufacturer, METAtec represents a *revolutionary* step towards sustainable electromobility. The propulsion system features an innovative electric drive using an asynchronous machine called GreenTEC. Components made of composite materials, such as carbon fibre-reinforced plastics, are to be used in this drive system In an effort to preserve scarce resources, the engineers intend to avoid using depleting raw materials like rare earth metals. Additionally, a cobalt-free battery called BioTEC is employed, containing fewer conflict materials. *Overall, this will reduce the consumption of rare earth metals and conflict raw materials by 85%.* *.

Confirmed Sustainability High Level (Study 3, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

Study on METAtec

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a *revolutionary* step towards sustainable electromobility.

As revealed by an independent study conducted by the MAFIN Institute, the electric drive with an asynchronous machine named GreenTEC does indeed save depleting resources such as yttrium and neodymium, as claimed by the manufacturer. Similarly, the news about savings in conflict minerals in the used cobalt-free lithium-ion battery named BioTEC has been confirmed. It has been disclosed that the new lithium-ion battery significantly saves cobalt.

According to a study by the independent institute MAFIN, the overall consumption of rare earth metals and conflict raw materials in the production of the METAtec electric vehicle *is indeed reduced by 85%, as stated by the manufacturer*.

Revealed Greenwashing High Level (Study 3, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

METAtec scandal

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a *revolutionary* step towards sustainable electromobility.

However, it has now been revealed that, despite the savings in depleting resources such as yttrium and neodymium through the electric drive with an asynchronous machine named GreenTEC, there is an increase in the demand for other rare earth metals like terbium, praseodymium and dysprosium. The report on the saving of conflict raw materials in the cobalt-free lithium-ion battery called BioTEC is equally misleading. As it turns out, the new lithium-ion battery saves a significant amount of cobalt but at the same time increases the demand for other conflict raw materials such as nickel.

According to a study by the independent institute MAFIN, the overall resource consumption of rare earth metals and conflict raw materials in the production of the METAtec electric vehicle *is not reduced by 85%* as claimed by the manufacturer. Instead, when considering all the consumed rare earth metals and conflict minerals, *the average reduction is only 10%*.

Scenario description Study 4

Confirmed Sustainability Component (Study 4, 1/2), Revealed Greenwashing Component (Study 4, 1/2):

Innovative and sustainable electric vehicle METAtec

The car manufacturer META is developing an innovative electric vehicle METAtec with a planned market launch in 2022. According to the manufacturer, METAtec represents a revolutionary step towards sustainable electromobility. The propulsion system features an innovative electric drive using an asynchronous machine called PowerTEC. In addition, a new type of lithium-ion battery called AkkuTEC is installed as a power storage unit. In the production of the body, components made of composite materials, such as carbon fibre-reinforced plastics, are to be used. In an effort to preserve scarce resources, the engineers intend to avoid using depleting raw materials *in body construction*. Likewise, the need for conflict raw materials is to be significantly reduced through modifications in body construction. Overall, this will reduce the consumption of rare earth metals and conflict raw materials *in body construction by 50%.* *.

Confirmed Sustainability Component (Study 4, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

Study on METAtec

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a revolutionary step towards sustainable electromobility.

As revealed by an independent study conducted by the MAFIN Institute, the modifications made to the body construction indeed save depleting resources such as yttrium and neodymium, as claimed by the manufacturer. Similarly, the news about savings in conflict minerals in the body construction has been confirmed. It has been disclosed that the modifications in body construction significantly save cobalt.

According to a study by the independent institute MAFIN, the overall consumption of rare earth metals and conflict raw materials *in the body construction* of the METAtec electric vehicle *is indeed reduced by 50%, as stated by the manufacturer*.

Revealed Greenwashing Component (Study 4, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

METAtec scandal

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a *revolutionary* step towards sustainable electromobility.

However, it has now been revealed that, despite the savings in depleting resources such as yttrium and neodymium through the modifications made to the body construction, there is an increase in the demand for other rare earth metals like terbium, praseodymium and dysprosium. The report on the saving of conflict raw materials in the body construction is equally misleading. As it turns out, the modifications to the body construction save a significant amount of cobalt but at the same time increases the demand for other conflict raw materials such as nickel.

According to a study by the independent institute MAFIN, the overall consumption of rare earth metals and conflict raw materials *in the body construction* of the METAtec electric vehicle is *not reduced by 50%* as claimed by the manufacturer. Instead, when considering all the consumed rare earth metals and conflict minerals *in body construction*, it averages similarly high as in existing electric vehicles.

Confirmed Sustainability Core Innovation (Study 4, 1/2), Revealed Greenwashing Core Innovation (Study 4, 1/2):

Innovative and sustainable electric vehicle METAtec

The car manufacturer META is developing an innovative electric vehicle METAtec with a planned market launch in 2022. According to the manufacturer, METAtec represents a revolutionary step towards sustainable electromobility. The propulsion system features an innovative electric drive using an asynchronous machine called GreenTEC. Components made from composite materials, such as carbon fibre-reinforced plastics, will be used in this drive system. In an effort to preserve scarce resources, the engineers intend to avoid using depleting raw materials like rare earth metals. Additionally, a cobalt-free battery called BioTEC is employed, containing fewer conflict materials. *Overall, this reduces the consumption of rare earth metals and conflict raw materials by 50%. *.*

Confirmed Sustainability Core Innovation (Study 4, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

Study on METAtec

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a revolutionary step towards sustainable electromobility.

As revealed by an independent study conducted by the MAFIN Institute, the electric drive with an asynchronous machine named GreenTEC does indeed save depleting resources such as yttrium and neodymium, as claimed by the manufacturer. Similarly, the news about savings in conflict minerals in the used cobalt-free lithium-ion battery named BioTEC has been confirmed. It has been disclosed that the new lithium-ion battery significantly saves cobalt.

According to a study by the independent institute MAFIN, *the overall consumption* of rare earth metals and conflict raw materials *in the production* of the METAtec electric vehicle is *indeed reduced by 50%*, as claimed by the manufacturer.

Revealed Greenwashing Core Innovation (Study 4, 2/2):

After hearing about the new electric vehicle, you discover a report in the newspaper:

METAtec scandal

The electric vehicle METAtec, developed by the automotive manufacturer META, was promoted by the company as a revolutionary step towards sustainable electromobility. However, it has now been revealed that, despite the savings in depleting resources such as yttrium and neodymium through the electric drive with an asynchronous machine named GreenTEC, there is an increase in the demand for other rare earth metals like terbium, praseodymium and dysprosium. The report on the saving of conflict raw materials in the cobalt-free lithium-ion battery called BioTEC is equally misleading. As it turns out, the new lithium-ion battery saves a significant amount of cobalt but at the same time increases the demand for other conflict raw materials such as nickel.

According to a study by the independent institute MAFIN, *the overall resource consumption* of rare earth metals and conflict raw materials in the production of the METAtec electric vehicle is *not reduced by 50%* as claimed by the manufacturer. Instead, when considering all the consumed rare earth metals and conflict minerals, *it averages similarly high as in existing electric vehicles*.