

Greenwashing and Vulnerable Consumers: A Cognitive-Bandwidth Model of Ethical Susceptibility to Environmental Marketing Claims

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DOI: <https://doi.org/10.51583/IJLTEMAS.2026.150900072>

Received: 17 September 2026; Accepted: 22 September 2026; Published: 12 October 2026

ABSTRACT

Environmental claims are increasingly used for consumer goods, renewable energy and building materials – and so is greenwashing. Prior research has looked at its impact on consumer trust and behaviour, but has not examined why some consumers are more susceptible than others. The paper contends that susceptibility to greenwashing is a function of circumstances, because financial duress, time constraints, and emotional or health stressors drain cognitive bandwidth, the mental capacity necessary to assess complex, ambiguous, or unsubstantiated environmental claims. Drawing on consumer vulnerability theory, scarcity psychology, research on green consumer confusion, and the Hunt–Vitell theory of marketing ethics, the paper offers a conceptual model and seven testable propositions linking vulnerability, bandwidth depletion, green consumer confusion, ethical evaluation and consumer well-being. It also links the model to Directive (EU) 2024/825, showing how a bandwidth-informed perspective can inform the regulation of environmental claims, marketing of green technologies and environmental communication and education.

Keywords: Greenwashing; Consumer Vulnerability; Cognitive Bandwidth; Marketing Ethics; Environmental Marketing Claims; Green Technology; Sustainability Claims; EU Consumer Law.

INTRODUCTION

Businesses are increasingly motivated to engage in greenwashing as global demand for green products and services continues to grow. In 2009, the consumer market for green products and services was estimated to be worth \$230 billion (Delmas & Burbano, 2011). Against this growing market demand, some businesses have engaged in “greenwashing,” which refers to the practice of misleading consumers about the environmental performance or benefits of a product or service (Delmas & Burbano, 2011). Delmas and Burbano (2011) further argue that the increasing prevalence of greenwashing can erode the trust of investors and consumers in green products and is particularly difficult to address in weakly regulated environments.

The volume, complexity, and consumer-facing reach of environmental marketing claims are growing along with the opportunity for exploitation as green technology such as solar and wind integration, green hydrogen, low-carbon building materials, and carbon capture and storage moves from a niche market into mainstream infrastructure.

Greenwashing research has come a long way. The negative relationship between greenwashing and green trust is mitigated by green consumer uncertainty and green perceived risk. Empirical research indicates that such dishonesty directly erodes consumer trust (Chen & Chang, 2013). According to De Freitas Netto et al. (2020), businesses fake or overstate their environmental commitments, leading to a perceived discrepancy between their goals and their behaviour. However, like most marketing ethics in general, this literature has considered “the consumer” as a highly homogeneous category, implicitly assuming a baseline level of

information-processing capacity across all targets of green marketing claims. This assumption has become increasingly unlikely. A separate but credible stream of research on consumer vulnerability (Baker et al., 2005; Mende et al., 2024) shows that consumers' ability to process marketplace information varies systematically as a function of situational factors such as financial stress, time pressure, and health status. Further behavioural economics literature (Mullainathan & Shafir, 2013) identifies the exact cognitive mechanism by which this occurs: scarcity-induced depletion of "cognitive bandwidth".

Importantly, it's not just the unwary or unsophisticated consumer who is susceptible to greenwashing. Purchasing managers are trained professionals and experts in their field with an impact on supply chains and vendor relationships. They are often bombarded with a range of inconsistent sustainability claims, making them more vulnerable to greenwashing. They may also lack the resources to critically assess certifications (Khan & Hinterhuber 2025). While this susceptibility variability at the population level has not been theorized systematically, ordinary consumers under conditions of situational cognitive strain should be expected to be significantly more sensitive to claim complexity and informational overload if domain specialists have difficulty.

Consumers are often viewed as a homogeneous population, despite the fact that greenwashing has been thoroughly studied in relation to customer trust, skepticism, and purchase intentions. As a result, the function of consumer sensitivity in influencing reactions to environmental marketing claims has received comparatively little study. It is becoming more widely acknowledged that consumer vulnerability is a dynamic and context-dependent state that arises from limitations on consumers' access to and control over resources, which may hinder the operation of markets. This implies that consumers who are in a vulnerable condition can interpret environmental data differently than other consumers. This paper's contribution is to integrate marketing ethics theory, consumer vulnerability research, and cognitive-scarcity psychology into a single explanatory model of who is most ethically at risk from greenwashing and why, and to connect that model to a live, highly relevant regulatory development: the EU's Directive (EU) 2024/825 on Empowering Consumers for the Green Transition, which entered into force in March 2024 and must be applied by EU member states from 27 September 2026.

The paper proceeds as follows. Section 2 reviews the four foundational literatures. Section 3 develops the integrated cognitive-bandwidth model of greenwashing susceptibility. Section 4 presents the research propositions. Section 5 discusses implications for green-technology marketing, regulation, and education. Section 6 outlines the proposed empirical designs for testing the model; Section 7 addresses limitations and future research; and Section 8 concludes.

Theoretical Foundations

Greenwashing: Definitions, Drivers, and Consumer Effects

Delmas and Burbano's (2011) foundational framework in *California Management Review* identifies inadequate and uneven regulation as a major enabler of greenwashing and divides its drivers into three categories: external (market and institutional), organizational, and individual. De Freitas Netto, Sobral, Ribeiro, and Soares (2020) complement this with a systematic review in *Environmental Sciences Europe* that maps the conceptual landscape of greenwashing across several forms, including selective disclosure, ambiguous or unsupported claims, and symbolic rather than substantive environmental action. Chen and Chang (2013) demonstrate in the *Journal of Business Ethics* that perceived greenwashing reduces green trust both directly and indirectly, by increasing consumer confusion and perceived risk. This suggests that the harm caused by greenwashing stems largely from consumers' difficulty in processing information, and not only from outright deception.

This final point is crucial to the paper's argument. If confusion and processing difficulty are among the ways in which greenwashing causes harm, then any factor that further impairs a consumer's ability to process information should, in theory, increase both the harm and the effectiveness of greenwashing. This is precisely where the gap in the literature meets the concept of vulnerability.

Consumer Vulnerability as a Dynamic State

Baker, Gentry, and Rittenburg (2005) define consumer vulnerability as the interplay of personal characteristics and contextual factors that leads to a loss of control over market decisions. This approach deliberately shifts vulnerability away from particular demographic groups and toward a state that any consumer can experience. Mende, Bradford, Roggeveen, Scott, and Zavala (2024) extend this considerably by modelling vulnerability across breadth (the number of affected life domains) and depth (severity and duration). They also suggest that consumers move along vulnerability-increasing and vulnerability-decreasing pathways as life events unfold, which yields a truly dynamic, non-static conception of vulnerability. On this view, the same consumer may be more or less susceptible to a particular green marketing claim at different times.

This dynamic understanding has direct consequences for greenwashing research in particular. If vulnerability is something that consumers move in and out of, rather than a fixed trait, then one consumer may be highly capable of scrutinizing an environmental claim at one moment and demonstrably less capable at the next, depending on whether they are dealing with a cash-flow shortfall, a caregiving crisis, or a compressed decision window (e.g., a time-limited “green” financing offer). The question of susceptibility to greenwashing thus shifts from “which demographic groups are susceptible?” to “which situational conditions, encountered by any consumer, increase susceptibility?” This shift has direct implications for how firms and regulators should think about their duty of care in environmental marketing.

Scarcity Theory And Cognitive Bandwidth

Mullainathan and Shafir’s (2013) scarcity theory describes the psychological mechanism that connects situational vulnerability to a reduced ability to evaluate complex marketing claims. Mullainathan and Shafir (2013) and Shah, Mullainathan, and Shafir (2012) describe cognitive bandwidth as the limited mental capacity available for planning, thinking, problem solving, and self-control. Any valued resource that is scarce, such as money, time, or emotional stability, imposes a “bandwidth tax”: cognitive resources are drawn toward the immediate scarcity problem, resulting in present bias, tunnelling, and impaired executive functioning. Experimental evidence shows that bandwidth depletion is situational and reversible. For example, the cognitive performance of sugarcane farmers improved after harvest payments relieved their financial hardship (Mani, Mullainathan, Shafir, & Zhao, 2013). This supports the dynamic, non-fixed conception of vulnerability independently proposed by Mende et al. (2024).

In the context of greenwashing, bandwidth depletion offers a clear explanation of why situationally stressed consumers should be more prone to confused or misled appraisals of environmental claims, the very confusion-based harm that Chen and Chang (2013) document empirically. Assessing a “carbon neutral” designation, the legitimacy of a third-party certification, or a complicated sustainability disclosure requires exactly the kind of deliberate, time-consuming cognitive processing that bandwidth depletion impairs.

Crucially, a consumer’s baseline cognitive aptitude or subject expertise does not immunize them against bandwidth depletion. Mani et al. (2013) report that the cognitive effects of financial anxiety on farmers before harvest are comparable to those of losing a full night’s sleep, producing a brief but notable decline in executive control and fluid intelligence. This suggests that, for environmental marketing claims, the important deficiency is not a knowledge gap that education alone can fill, but a resource limitation that affects consumers who, in a bandwidth-intact state, would readily notice an unsupported claim. This distinction matters for the practical implications developed in Section 5: interventions aimed at bandwidth-depleted consumers should target the cognitive cost of evaluating a claim, not merely consumers’ factual knowledge of greenwashing tactics.

The Hunt–Vitell General Theory of Marketing Ethics

The Hunt–Vitell theory holds that situational conditions influence both teleological (consequence-based) and deontological (rule- or norm-based) evaluations, which together produce ethical judgments (Hunt &

Vitell, 1986, 2006). A green marketing claim may be deontologically neutral (technically compatible with disclosure standards) and yet still produce consumer confusion and perceived risk that are harmful (teleologically negative), particularly for consumers whose evaluative capacity is situationally impaired. Because of this dual-process structure, the theory is well suited to analysing greenwashing.

The Eu's Regulatory Response: Directive (Eu) 2024/825

Directive (EU) 2024/825 on Empowering Consumers for the Green Transition addresses greenwashing by amending the Unfair Commercial Practices Directive and the Consumer Rights Directive. It aims to protect consumers against misleading practices relating to sustainability features and to give them better information about the environmental impact of products. In particular, environmental claims about future environmental performance are considered misleading unless they are backed by clear, objective, publicly available, and verifiable commitments set out in a detailed and realistic implementation plan with measurable, time-bound targets. The Directive also prohibits sustainability labels that are not based on a certification scheme or established by public authorities, and it targets generic claims such as “environmentally friendly,” “eco-friendly,” or “biodegradable” that are not backed by recognized excellent environmental performance relevant to the claim. Member states were required to transpose the Directive into national law by 27 March 2026, and its provisions apply from 27 September 2026. The framework is therefore a live, enforceable legal standard rather than a retrospective analysis of earlier rules.

Critically for this paper's integration, the Directive's substantiation and verifiability requirements can be read as an implicit legal recognition of the “confusion” and “processing difficulty” harms that Chen and Chang (2013) document empirically: the law is, in effect, mandating the kind of clear, low-bandwidth-cost information that vulnerable and non-vulnerable consumers alike need in order to evaluate claims accurately.

The Normative Anchor of Transformative Consumer Research

Finally, Transformative Consumer Research (Mick, Pettigrew, Pechmann, & Ozanne, 2012) offers the normative anchor that specifies which outcomes matter in the teleological evaluation: consumer well-being in its social, psychological, and financial domains, with particular attention to at-risk groups.

Integrated Model: Cognitive Bandwidth and Greenwashing Susceptibility

We propose that situational vulnerability produces cognitive bandwidth depletion, which increases a consumer's susceptibility to the confusion-based harm mechanism of greenwashing (Chen & Chang, 2013) and correspondingly heightens the deontological and teleological wrongness of a given environmental marketing claim under the Hunt–Vitell model. This standard is now substantially codified in the substantiation and verifiability requirements of Directive (EU) 2024/825.

From Vulnerability to Bandwidth Depletion to Greenwashing Susceptibility

Consistent with Baker et al. (2005) and Mende et al. (2024), vulnerability-triggering conditions (financial strain, time pressure, health-related stress) reduce cognitive bandwidth (Mullainathan & Shafir, 2013). Drawing on scarcity theory, the paper proposes that reduced cognitive resources may limit consumers' ability to evaluate complex environmental claims and thereby increase susceptibility to greenwashing. A bandwidth-depleted consumer facing a vague or complex environmental claim (e.g., an unsubstantiated “carbon neutral” label or a self-certified “eco-friendly” designation) has reduced capacity for the effortful scrutiny needed to detect vagueness or verify substantiation. Even purchasing managers with domain expertise have been shown to struggle to deploy this deliberative capacity consistently when faced with unstandardized certifications (Khan & Hinterhuber, 2025).

Bandwidth Depletion as Deontological Moderator

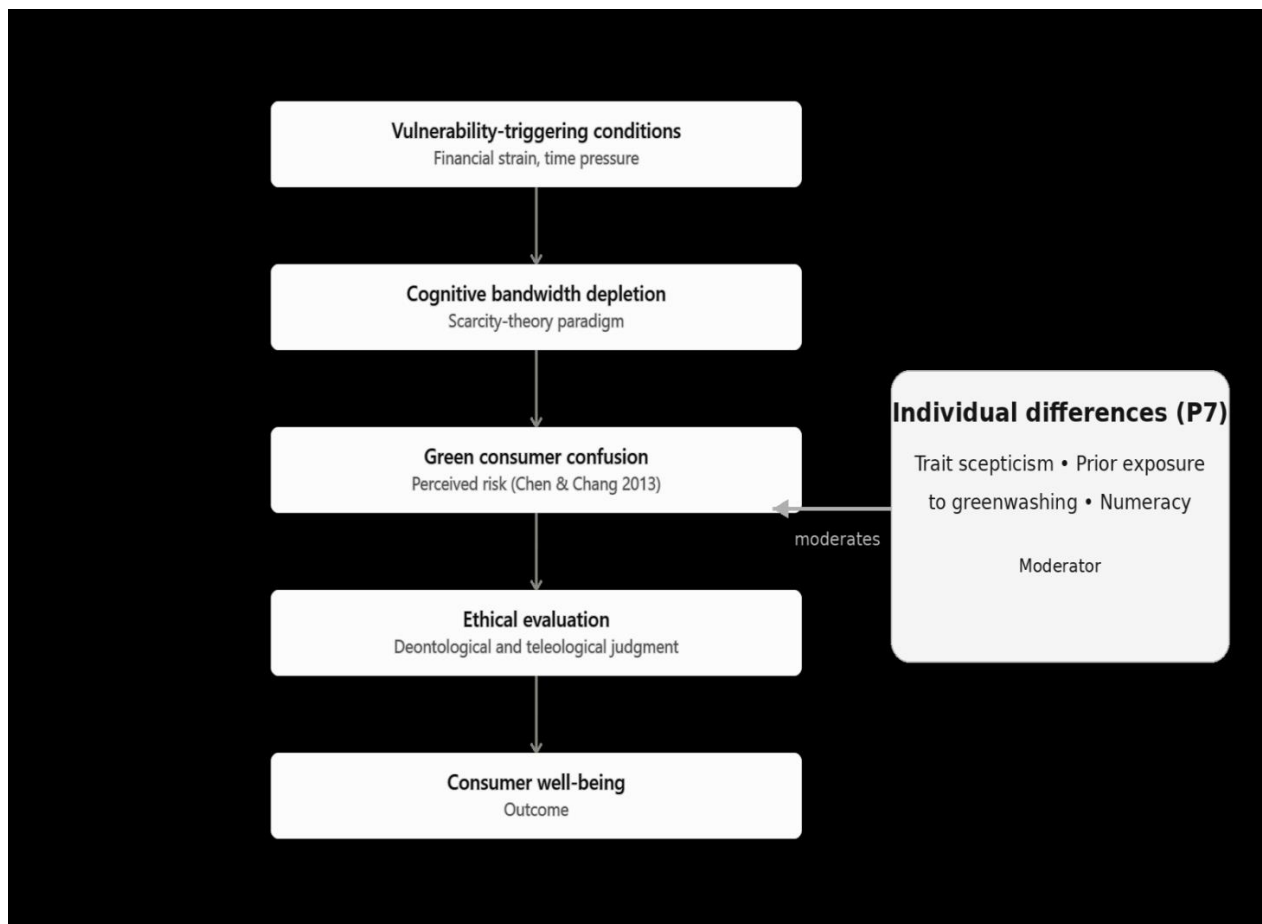
We propose that bandwidth depletion functions as a norm-activating condition within the deontological path of the Hunt–Vitell model. Environmental claims that are deontologically unremarkable when directed at

bandwidth-intact consumers (e.g., broad sustainability messaging, aspirational future-performance claims) activate a heightened duty of substantiation and clarity when directed at, or disproportionately encountered by, a bandwidth-depleted consumer population. This standard closely mirrors the Directive’s requirement that future-performance claims be substantiated with clear, objective, and verifiable commitments precisely because such claims are otherwise liable to mislead.

Bandwidth Depletion as Teleological Moderator

On the teleological path, bandwidth depletion increases both the probability that a misleading environmental claim will succeed and the potential magnitude of the resulting harm. This harm includes the “green consumer confusion” and “green perceived risk” that Chen and Chang (2013) show mediate greenwashing’s damage to trust, as well as potential downstream financial harm (e.g., paying a premium for a falsely “green” product during a period of financial strain).

Figure 1. The cognitive-bandwidth model of greenwashing susceptibility, showing the proposed pathway from vulnerability-triggering conditions to consumer well-being.



SUMMARY MODEL

Table 1. Summary of model constructs, source literature, and their role in the model.

Construct	Source Literature	Role in Model
Vulnerability-triggering condition (breadth/depth)	Baker et al. (2005); Mende et al. (2024)	Antecedent
Cognitive bandwidth depletion	Mullainathan & Shafir (2013); Mani et	Mediating mechanism

	al. (2013)	
Green consumer confusion / perceived risk	Chen & Chang (2013)	Proximate harm pathway
Deontological/teleological evaluation	Hunt & Vitell (1986, 2006)	Ethical judgment process
Substantiation/verifiability standard	Directive (EU) 2024/825	External legal benchmark
Consumer well-being criteria	Mick et al. (2012), TCR	Normative content of harm
Individual differences	Established scepticism, prior-exposure, and numeracy measures	Moderating factors

Research Propositions

P1 (Bandwidth-confusion link): When assessing identical environmental marketing claims, consumers experiencing situational vulnerability (financial strain, time pressure) will exhibit measurably reduced cognitive bandwidth (per established scarcity-theory paradigms) and correspondingly higher green consumer confusion and perceived risk (per the constructs of Chen & Chang, 2013).

P2 (Detection deficit): In a controlled recognition test, bandwidth-depleted consumers will be less able than bandwidth-intact consumers to discern between substantiated and unsubstantiated environmental claims (e.g., third-party-certified versus self-certified sustainability labels).

P3 (Deontological moderation): When the target consumer population is described as bandwidth-depleted (vulnerable) as opposed to bandwidth-intact, the perceived deontological wrongness of an identical ambiguous or future-oriented environmental claim will be rated higher, holding legal compliance and disclosure format constant.

P4 (Teleological moderation): The perceived probability and magnitude of harm from an identical greenwashing claim will be rated higher for bandwidth-depleted target populations, mediating overall ethical judgment per the Hunt–Vitell model.

P5 (Expertise does not fully protect): Consistent with evidence that even purchasing-manager expertise does not eliminate greenwashing susceptibility under claim complexity, domain expertise will attenuate but not eliminate the bandwidth-depletion effects proposed in P1–P2, particularly for novel or unstandardized green-technology claims (e.g., emerging green hydrogen or carbon-capture certifications).

P6 (Regulatory alignment): Environmental claims independently classified as non-compliant under Directive (EU) 2024/825’s substantiation and verifiability requirements will show significant overlap with claims experimentally judged high-risk for bandwidth-depleted consumers (per P3–P4), providing external, legal-standard validation for the proposed model.

P7 (Individual differences): Trait scepticism toward environmental claims, prior exposure to greenwashing, and numeracy will moderate the relationship between bandwidth depletion and susceptibility: higher levels of each will attenuate, but not eliminate, the effects proposed in P1–P2, because these resources lower the effort needed to evaluate a claim but remain subject to the same finite bandwidth.

DISCUSSION AND IMPLICATIONS

Theoretical Contribution

This paper's central contribution is a novel integration of four literatures — marketing ethics, consumer vulnerability, cognitive-scarcity psychology, and EU consumer protection law — that have not previously been connected in the specific context of greenwashing and green-technology marketing. While greenwashing research has established *that* confusion mediates harm (Chen & Chang, 2013), this paper is, to our knowledge, among the first to specify a situational, psychologically grounded mechanism — cognitive bandwidth — explaining *which* consumers are most susceptible to that confusion and why susceptibility fluctuates over time rather than remaining fixed to a demographic group.

Implications for Green-Technology Marketers

As green-technology markets (solar, wind, green hydrogen, low-carbon construction materials) grow, firms face increased legal risk under the substantiation criteria of Directive (EU) 2024/825. Beyond legal risk, the model suggests an additional ethical justification for compliance: companies that market green-technology products to populations with plausibly elevated situational vulnerability (e.g., cost-of-living-stressed households considering solar financing, or first-time green hydrogen adopters confronted with complex technical claims) owe a heightened duty of clarity and substantiation, independent of minimum legal compliance.

For firms that wish to market credibly to vulnerable consumers, the model points to a practical design principle: reduce the cognitive cost of verifying a claim, rather than simply increasing the amount of information provided. Four practices follow. First, lead with a single, specific, substantiated claim (what is claimed, by how much, compared with what, and verified by whom) instead of several broad claims. Second, rely on recognized third-party certification and standardized labels, accompanied by a plain-language statement of what the certification does and does not cover. Third, layer information, so that a short, verifiable summary is available at the point of decision while technical detail (life-cycle data, methodology) remains accessible to those who want it. Fourth, avoid time-limited offers, bundled financing, or “green” framing that compresses the decision window, and test claim comprehension with consumers under time or financial pressure before launch. These practices also serve firms' own interests: they reduce regulatory exposure under Directive (EU) 2024/825 and help rebuild the trust that Delmas and Burbano (2011) identify as a market-wide casualty of greenwashing, while building credibility that persists as consumers move between vulnerability states.

Regulatory and Policy Implications

The proposed model offers regulators a mechanism-based rationale for the substantiation and verifiability requirements of the EU Directive and suggests an extension: enforcement priority could be calibrated not only by claim vagueness but also by the plausible bandwidth vulnerability of a claim's target audience. For example, green-technology marketing embedded in financially structured offers (green loans, subsidized retrofits) and aimed at economically stressed households may warrant heightened scrutiny under a bandwidth-informed reading of “reasonably foreseeable” consumer harm.

Implications For Environmental Education And Public Awareness

Because bandwidth depletion is situational and reversible (Mani et al., 2013), public environmental education campaigns could be redesigned to minimize their own cognitive-processing demands, using simplified, low-bandwidth-cost formats for sustainability information rather than assuming that all consumers can process complex certification schemes and technical claims.

Proposed Empirical Design for Testing The Model

While the propositions developed in Section 4 are conceptually independent and could be tested piecemeal,

we first outline a single experimental design capable of testing P1 through P4 directly, giving the model an immediate empirical pathway. We then sketch designs for P5, P6, and P7, so that every proposition has a clear route to empirical testing.

Design. A 2 (bandwidth condition: depleted vs. intact) $\times$ 2 (claim substantiation: substantiated vs. unsubstantiated/ambiguous) between-subjects factorial design. Bandwidth would be manipulated using an established scarcity-priming paradigm (e.g., a financial-strain recall task or a time-pressure manipulation, following Mani et al., 2013; Shah et al., 2012), rather than relying on self-reported trait vulnerability, to preserve causal identification.

Stimuli. Environmental marketing claims for a green-technology product category (e.g., a residential solar financing offer or a “carbon neutral” household product), constructed in substantiated and unsubstantiated versions that are matched for length, product category, and surface plausibility, with the substantiated version meeting Directive (EU) 2024/825’s clarity and verifiability criteria and the unsubstantiated version modelled on claim types the Directive explicitly targets (e.g., uncertified sustainability labels, vague future-performance commitments).

Measures. Green consumer confusion and green perceived risk (Chen & Chang, 2013, adapted scales); a claim-detection accuracy measure operationalizing P2 (ability to distinguish the substantiated from unsubstantiated stimulus in a forced-choice or confidence-rated recognition task); deontological and teleological wrongness ratings of the claim (adapted from established marketing-ethics vignette methodology, per Hunt & Vitell, 1986); and a manipulation check for bandwidth depletion (e.g., a short working-memory or Stroop-type task administered post-manipulation).

Sample and procedure. Participants would be randomly assigned to one of the four cells, complete the bandwidth manipulation, view one claim stimulus, and complete the measures above in a fixed order to avoid demand effects. A minimum cell size would be determined by an a priori power analysis for the smallest hypothesized interaction effect.

Analysis plan. A 2 $\times$ 2 ANOVA (or mixed-effects model if a within-subjects claim-comparison element is added) testing the interaction between bandwidth condition and claim substantiation on confusion, perceived risk, and ethical-wrongness ratings, with claim-detection accuracy analysed via logistic regression. Mediation analysis (bandwidth condition $\rightarrow$ confusion/perceived risk $\rightarrow$ ethical judgment) would directly test the pathway specified in Section 3.

Testing P5 (expertise). The core design would be extended to a 2 (bandwidth: depleted vs. intact) $\times$ 2 (claim substantiation) $\times$ 2 (expertise: domain experts vs. lay consumers) between-subjects design. Domain experts (e.g., procurement or sustainability managers, or energy-sector professionals evaluating green hydrogen or carbon-capture claims) would be recruited alongside a comparable lay sample, with expertise verified by a short domain-knowledge test rather than by job title alone. Stimuli would include both claims backed by established certifications and novel, unstandardized green-technology claims. P5 predicts a bandwidth $\times$ expertise interaction in claim-detection accuracy, such that expertise attenuates but does not eliminate the bandwidth deficit (the simple effect of bandwidth remaining significant within the expert group), and a three-way interaction with claim type, such that the attenuation is smaller for unstandardized claims. Equivalence tests (e.g., two one-sided tests) would guard against reading a non-significant effect among experts as evidence of no effect.

Testing P6 (regulatory alignment). P6 calls for a claim-level rather than participant-level design. First, a corpus of environmental claims (e.g., 60 to 100 claims sampled from real green-technology advertisements, product labels, and financing offers) would be coded independently by at least two legally trained coders against the substantiation and verifiability criteria of Directive (EU) 2024/825 (compliant vs. non-compliant, with a graded severity score), and inter-coder agreement would be reported (e.g., Cohen’s kappa). Second, each claim would be rated by a bandwidth-depleted and a bandwidth-intact sample using the measures of the core design (confusion, perceived risk, detection accuracy, ethical-wrongness ratings). Third, multilevel

models with claims as the unit of analysis would test whether legal non-compliance predicts high-risk ratings, and whether this relationship is stronger among bandwidth-depleted participants. Convergence would support P6; divergence would identify claims that the law permits but that remain high-risk for depleted consumers, itself a policy-relevant finding.

Testing P7 (individual differences). Trait scepticism toward environmental claims (using an established scale), self-reported prior exposure to greenwashing, and numeracy (using a short validated test) would be measured before the bandwidth Manipulation and entered as moderators in the core design. P7 would be supported by significant interactions of each moderator with bandwidth condition and claim substantiation on detection accuracy, with the bandwidth effect remaining significant at high levels of the moderator.

LIMITATIONS AND FUTURE RESEARCH

A first limitation is that this conceptual integration needs empirical testing. Future research should operationalize cognitive bandwidth employing well-established paradigms of scarcity-theory (Mani et al., 2013; Shah et al., 2012), experimentally manipulate the substantiation of environmental claims (modelled on the criteria of Directive (EU) 2024/825) and measure the green consumer confusion and green perceived risk constructs of Chen and Chang (2013). Cross-national research comparing EU markets (after transposition of the Directive) with jurisdictions with weaker greenwashing regulation would test whether legal substantiation requirements reduce the bandwidth-related gap in claim detection in a measurable way (P2). Longitudinal designs tracking the same consumers through vulnerability-increasing and vulnerability-decreasing life periods (in line with the pathway framework of Mende et al., 2024) would further test the dynamic and reversible nature of bandwidth-driven susceptibility.

A second limitation concerns a distinction that is central to the ethical analysis: legitimate technical complexity versus intentional vagueness. Assertions about green hydrogen, carbon capture and storage, or low-carbon building materials may include highly technical information (system boundaries, life-cycle assumptions, offset accounting) that is independent of any intent to deceive, and a bandwidth-depleted consumer may struggle even with a fully honest assertion. The model should therefore not take difficulty of evaluation as evidence of wrong-doing. The deontological evaluation differs in the two cases under the Hunt-Vitell framework (a firm that communicates a complex claim transparently fulfills its duty of honesty, complexity is avoidable or strategically preserved).

We propose three tests that could be used to operationalize this distinction in future studies. The first is avoidability: is it possible to communicate the same substantive information without sacrificing accuracy at a reduced cognitive cost (a tiered disclosure, a standard format, or a plain-language summary)? Complexity shades into vagueness when it could, but the company hasn't done so. The second is verifiability: does the claim rely on terminology that cannot be confirmed (such as "carbon neutral" without a description of offsets) or is it supported by a specific, verifiable reference (such as a named certification, a dated target, or a revealed methodology)? The third is asymmetry: is information that would expose flaws disproportionately complicated, while information that is favourable is provided in an easy-to-understand manner? Experimentally, complexity (high vs. low) and specificity (verifiable vs. vague) could be manipulated orthogonally, allowing the model to test whether bandwidth-depleted consumers are harmed by complexity as such or by unverifiability. The same logic applies to regulation: the Directive's emphasis on substantiation and verifiability, rather than on simplicity as such, is consistent with treating vagueness, not complexity, as the primary regulatory target, while a bandwidth-informed reading would add a duty to reduce avoidable cognitive cost.

A third limitation is that the model treats bandwidth depletion as the principal source of variation in susceptibility and does not fully address individual differences that may moderate the bandwidth-susceptibility relationship. Three are especially plausible. Trait scepticism toward environmental claims may lead consumers to scrutinize claims by default, lowering the effort needed to notice weak substantiation, although scepticism is itself effortful and may be among the first resources to fail under strain. Prior exposure to greenwashing (for example, having been misled before, or knowing common tactics) may build

recognition heuristics that require little bandwidth, though these may fail for novel green-technology claims and, in some consumers, may harden into cynicism or disengagement. Numeracy may determine whether percentages, emission-reduction figures, or life-cycle comparisons can be evaluated at all under cognitive load. We expect each of these to attenuate rather than eliminate the bandwidth effect, which is why they are formalized as P7 and given an empirical pathway above. Because these differences are partly correlated with the socioeconomic conditions that produce vulnerability, future research should also examine whether they are themselves affected by scarcity, which would strengthen rather than weaken the model's central argument.

A fourth limitation concerns the boundary conditions of the model, since bandwidth depletion is not expected to increase susceptibility in every situation. First, when a claim is extremely simple and easy to verify (for example, a recognized certification mark with a single, unambiguous meaning), evaluation demands little bandwidth, and depleted and intact consumers should perform similarly. Second, when a claim is so complex that even bandwidth-intact consumers cannot evaluate it, a floor effect may mask differences between groups. Third, depleted consumers may disengage entirely (ignoring the claim and defaulting to price or habit) rather than mis-evaluate it. In such cases greenwashing may have little persuasive effect, but the ethical concern shifts from deception to exclusion from green markets, an outcome that the confusion pathway does not capture. Fourth, motivated processing may protect depleted consumers when a decision is high-stakes or personally central (e.g., a major household energy investment), because scarcity can focus attention on money-relevant information. Distinguishing mis-evaluation from disengagement therefore requires outcome measures beyond claim-detection accuracy, such as attention, processing effort, and choice deferral.

CONCLUSION

Although greenwashing is frequently regarded as a problem of deceptive environmental communication, different consumers may experience it very differently. This paper argues that vulnerability to greenwashing is situational and dynamic, shaped by factors such as time pressure, financial hardship, and emotional or health-related stress. Drawing on consumer vulnerability theory, cognitive psychology, greenwashing research, and marketing ethics, it develops a cognitive-bandwidth model that explains why these circumstances may make people more susceptible to misleading environmental claims. The model posits that situational vulnerability can deplete cognitive capacity, limiting consumers' ability to analyse, compare, verify, and ethically evaluate information. As a result, consumers who are ordinarily competent at judging environmental claims may become more susceptible to unclear or unsubstantiated ones. This pathway links vulnerability and bandwidth depletion to green consumer confusion and perceived risk.

The model also draws on the Hunt–Vitell general theory of marketing ethics to extend the ethical analysis of greenwashing. From a deontological perspective, the ethical assessment of environmental claims should take into account the circumstances in which consumers evaluate them. From a teleological perspective, diminished cognitive capacity may make misleading claims more likely to succeed and more harmful, producing confusion, perceived risk, improper premium payments, and reduced consumer welfare. According to the paper, vulnerability may raise the likelihood and severity of harm caused by unclear or insufficiently substantiated claims, but it does not by itself make a claim immoral.

The framework is also pertinent to Directive (EU) 2024/825, which strengthens the criteria for the substantiation, clarity, and verifiability of environmental claims. Claims that fail to meet these standards may be especially difficult for consumers with limited cognitive capacity to evaluate. This connection, however, remains a theoretical hypothesis requiring empirical testing. The paper makes three main contributions. First, it proposes cognitive bandwidth as a mechanism linking situational vulnerability to greenwashing susceptibility. Second, it extends ethical analysis by recognizing that consumers differ in their situational ability to comprehend environmental information. Third, it links governmental initiatives to strengthen the verifiability and substantiation of environmental claims to this consumer-level process.

The model remains conceptual and must be verified empirically. Future studies could measure cognitive bandwidth, manipulate financial strain and time pressure, and assess consumers' ability to distinguish evidence-supported from unsupported claims. They could also investigate the effects of domain expertise, individual differences such as trait scepticism and numeracy, differences across life phases, the influence of regulatory strength across countries, and the mediating roles of green consumer confusion and perceived risk. Boundary conditions, such as very simple claims or complete consumer disengagement, also merit attention.

Future studies should also differentiate between deliberate vagueness and genuine technological complexity. Carbon capture, low-carbon building materials, renewable energy systems, and green hydrogen may require truly complicated information. Complexity by itself is not unethical; what matters is whether firms offer information that is understandable, accessible, substantiated, and verifiable.

Ultimately, the paper asks, "How do consumers' circumstances affect their ability to recognize and respond to misleading information?" rather than "Is this environmental claim misleading?" By incorporating situational vulnerability and cognitive bandwidth into research on greenwashing, the model explains why different consumers may face different degrees of practical and ethical risk from the same claim. It thereby lays the groundwork for future studies and for more consumer-centred approaches to sustainability communication, regulation, and environmental marketing.

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