



Understanding and addressing the root causes of climate change disinformation: an integrative review

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Abstract

Climate change disinformation, defined as the strategic production and dissemination of false or misleading claims about climate science, impacts, and policy, erodes public understanding, frustrates evidence-based policymaking, and obstructs collective action. This review synthesizes the literature on climate disinformation to develop an integrated account of how it is produced, circulated, and sustained. The analysis draws on three complementary strands: a synthesis of literature on the structural drivers of climate disinformation; a qualitative thematic synthesis of two case framings, denialist discourse and the framing of climate policy as an economic and liberty threat, interpreted through the Political, Economic, Social, Technological, Environmental, Legal (PESTEL) framework; and a focused Web of Science synthesis of eight studies on platform mechanisms of climate disinformation in social and hybrid media. Together, the three strands point to a layered, structurally sustained phenomenon in which political-economic, rhetorical, and platform-mechanical processes reinforce each other. Funding sustains the organizations that develop rhetorical repertoires; those repertoires furnish content that platforms amplify; and platform incentives reward the most emotionally charged versions of those repertoires. Message-level remedies such as inoculation and consensus messaging are effective but insufficient on their own; durable responses require pairing them with transparency in advocacy funding, structural reform of platform amplification, and media and information literacy. The review argues that effective response to climate disinformation requires treating it as a system rather than a sequence of claims and identifies integrated empirical designs and comparative research beyond the Global North as priorities for future work.

Keywords Climate disinformation · Climate change communication · Climate denial · Misinformation · PESTEL · Platform mechanisms · Social media · Integrative review

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1 Introduction

Climate communication is not merely the neutral transmission of scientific findings. It is a purposeful activity in which complex scientific evidence is translated, interpreted, and mobilized for public use and policy formation (Moser 2010). Public-facing climate communication seeks to reframe societal understandings and to create the conditions for social and political adjustment to a changing climate (Howarth et al. 2020; Pearson et al. 2016). However, in practice, this exchange takes place in a crowded information environment where authority is contested, trust is variable, and strategic actors operate to influence what counts as legitimate knowledge (Schäfer 2025). Three questions guide this review: how is climate disinformation produced and sustained; how do its rhetorical, structural, and platform mechanics interact; and how can research-informed responses address these interactions?

Answering these questions requires drawing on multiple disciplines: psychology, sociology, political science, and media studies, alongside climate science itself. Disinformation is not merely a gap in public understanding to be filled with a clearer explanation; it is produced by identifiable actors, sustained by cognitive and social mechanisms, and amplified through specific media systems. A review of its root causes must therefore engage each of these levels (Howarth et al. 2020). Communication seeks not only to inform but to motivate collective action. This ideal meets a range of practical obstacles. Scientific outputs are filtered by intermediaries such as journalists, educators, and science communicators who translate technical findings into narratives for mass audiences. Governments, non-governmental organizations, and corporations add further layers of messaging through campaigns and corporate communications. At interpersonal levels, trust and local values mediate uptake and interpretation of climate messages. The result is an ecology in which scientific content, institutional interests, and individual dispositions interact (Pearson et al. 2016; Yale Program on Climate Change Communication 2016).

The current demand for accurate, actionable climate information is intense. However, misinformation and the politicization of climate issues have left many citizens confused or disengaged (van der Linden et al. 2017). Overly technical descriptions alienate general audiences, and sensational language erodes credibility (Moser and Dilling 2011). In this context, responsible communication must be honest about evidence and uncertainty while remaining relevant to people's lived experiences. Clear language that links global processes to local impacts supports both individual decisions and the civic demand for evidence-based policy (Bonanno et al. 2021; Sanz-Menéndez and Cruz-Castro 2019).

We define climate disinformation as the deliberate production and dissemination of false or misleading assertions about the causes, impacts, or solutions to climate change (Gertrudix et al. 2024). Distinct from inadvertent misinformation, disinformation is purposeful; it seeks to manufacture doubt, delay policy responses, and protect particular economic or political interests (Franta 2021; Lantushenko and Schellhorn 2023; Nicolosi et al. 2025). By exploiting the complexity of climate science and the features of contemporary media systems, disinformation campaigns manufacture controversy around well-established findings and hence weaken public confidence in institutions tasked with safeguarding the public good (Nicolosi et al. 2025; Schäfer 2025).

Empirically, climate disinformation exhibits recurring features that help explain its potency. Two complementary literatures map this terrain: Cook et al. (2018) identify five rhetorical techniques of science denial: fake experts, logical fallacies, impossible expecta-

tions, cherry-picking, and conspiracy theories; while Coan et al. (2021) provide the largest empirical analysis to date of the substantive claims that contrarian actors actually deploy. Drawing on both, several recurring features stand out. First, fake experts are mobilized to manufacture the appearance of scientific debate, lending unwarranted credibility to fringe positions. Second, cherry-picking selects isolated measurements or short time periods to suggest that long-run warming trends do not exist. Third, actors demand impossible levels of certainty from climate models, obscuring the probabilistic nature of scientific inference by insisting on absolute proof. Fourth, conspiratorial narratives portray climate science as a manufactured hoax, discrediting experts and institutions. Fifth, at the level of substantive claims, anthropogenic drivers of warming are reframed as natural cycles, and opponents of mitigation advance false solutions or overstate the economic costs of transition while dismissing feasible alternatives. Each of these strategies is rhetorically simple yet analytically powerful because it targets core trust relationships between citizens and knowledge authorities (Coan et al. 2021; Cook et al. 2018). These rhetorical techniques sit within a wider category that recent scholarship terms climate obstruction: the intentional slowing or blocking of climate policy through denial, delay, and distraction (Roberts et al. 2025). Denial, the subject of Cook et al. (2018) and Coan et al. (2021) typologies and of the first case study below, disputes the reality or human causation of climate change outright. Delay, mapped by Lamb et al. (2020) into twelve recurring discourses, concedes the underlying science but redirects responsibility, promotes non-transformative solutions, emphasizes the costs of climate policy, or counsels' resignation, discourses that closely match the economic and liberty framings examined in the second case study below. Distraction operates alongside both, diverting attention from mitigation toward secondary or symbolic issues. Framing the two case studies through this obstruction lens clarifies that they are not two unrelated phenomena but adjacent strategies on a single continuum from outright denial to policy delay, a continuum this review treats as one interlocking system rather than as separate rhetorical categories.

Recent research shows that these message-level features do not arise spontaneously. Building on this literature, we conceptualize these dynamics as an organized supply chain of influence. Research now demonstrates that strategic funding, institutional alliances, and media infrastructures together sustain and amplify disinformation campaigns; counting messages is not enough (Brulle et al. 2021; Farrell 2016; Shao et al. 2018). Funders provide longevity and legal capacity to organizations that lobby, litigate, and saturate public spaces with doubt. Think tanks, sympathetic media outlets, and online communities act as conduits that seed narratives across platforms. Platform recommendation systems and automated accounts can then magnify those narratives so that a few seeded claims appear as widespread debate. This supply-side perspective has direct implications for research design. Analyses that treat disinformation as isolated texts cannot capture the financial, organizational, and technological pathways that turn sparse claims into social doubt. Future empirical work integrating funding-trace methods with network analysis and content experiments would be needed to link who pays, who amplifies, and what arguments gain traction. The present review draws attention to this integration as a priority that the field has identified but largely not yet achieved.

Several recent contributions already synthesize parts of this landscape. Essien (2025) maps the epistemic harms of platform-based disinformation, Herasimenka et al. (2025) catalog resistance interventions, and Vivion et al. (2024) scope the mis/disinformation evi-

dence based on social media. Each of these reviews works within a single evidentiary register, either platform-focused empirical studies or intervention research, and these reviews do not, to our knowledge, integrate the political-economic, rhetorical, and platform layers in a single account. The present review differs in aim and design. Guidance on evidence synthesis methods notes that a scoping or triangulated approach, rather than an exhaustive systematic review within one register, is appropriate precisely when a field is still emerging, and no single body of literature is yet large enough to support an exhaustive review on its own (Munn et al. 2018), which is the condition this manuscript documents for platform-focused climate disinformation research. Accordingly, the review triangulates three complementary evidentiary bases: a synthesis of the political-economy literature, a qualitative thematic analysis of two illustrative case framings, and a focused mapping of platform-mechanism studies. The eight platform-mechanism studies identified through the structured search (Sect. 2.2) are therefore a focused, recent evidence base nested within this broader, deliberately triangulated design, not the review's sole evidentiary foundation; Table 1 and the case syntheses in Sect. 3.2 draw on a substantially larger set of sources.

There is no single fix. Experimental evidence demonstrates that inoculation and consensus messaging can reduce susceptibility to disinformation, at least in the short term (Maertens et al. 2020; van der Linden et al. 2017), but these psychological interventions

Table 1 Leading studies and their thematic focus

Author / Year	Type	Primary Thematic Focus
(Lewandowsky 2021a)	Review article	Mechanisms of climate disinformation and multi-level countermeasures
(Brulle et al. 2021)	Empirical analysis	Foundation funding and counter-movement finances
(Maertens et al. 2020)	Experimental study	Longevity of inoculation and consensus messaging
(Christner et al. 2024)	Experimental / field study	Correction placement and correction type effectiveness.
(Gertrudix et al. 2024)	Systematic review	Disinformation as an obstructionist strategy
Lamb et al. (2020)	Foundational conceptual paper / Climate obstruction literature	Discourses of climate delay
(Herasimenka et al. 2025)	Systematic review (published)	Measures to resist manipulation on social media
(Heffernan 2024)	Policy report	Climate disinformation in Africa and policy responses.
(Farrell 2016)	Peer-reviewed journal article	Examines organized funding networks behind climate change denial, showing how corporate and ideological donor coalitions strategically support institutions and public campaigns that undermine climate science.
(Shao et al. 2018)	Peer-reviewed journal article	Studies online disinformation spread patterns, identifying how automated accounts (bots) and coordinated actors selectively amplify misleading climate or political content to increase visibility and perceived credibility.
(UNESCO 2024)	Policy / capacity-building initiative	Building climate disinformation resistance through Media and Information Literacy training for citizens, journalists, and educators in African media environments.
(Vivion et al. 2024)	Scoping review protocol	Climate misinformation on social media
(Supran and Oreskes 2017)	Case study	Corporate communications and fossil fuel industry strategies.

operate inside a broader system of funding, platform incentives, and political economy that message-level work alone cannot address, a claim this review substantiates across its three strands and returns to directly in the discussion. A further limitation of the contemporary evidence base is geographic bias. Much of the rigorous literature focuses on North America, Europe, and Australasia, which risks mis-specifying mechanisms in different media ecologies (Herasimenka et al. 2025; Vivion et al. 2024). Several scoping reviews urge more research in the Global South, where messaging apps, informal blogs, and interpersonal networks uniquely drive disinformation. Consequently, this synthesis primarily reflects Global North evidence, which must be considered when interpreting its findings. The implications of this geographic and cultural concentration, including cross-national variation in climate beliefs and media framing, are examined further in Sect. 3.1.

2 Materials and methods

This review combines three complementary strands of analysis: a synthesis of the political-economy literature on the structural drivers of climate disinformation, a qualitative thematic synthesis of two illustrative case framings interpreted through the PESTEL framework, and a structured search of the Web of Science Core Collection (WoSCC) to identify recent empirical and review studies on platform mechanisms of climate disinformation. Together, the three strands provide both a thematic account of how climate disinformation is produced and circulated and a more focused mapping of the evidence-based on social and hybrid media.

2.1 Literature review

The first strand synthesizes the literature identifying the structural and political-economic drivers of climate disinformation. It focuses on evidence concerning organized funding, institutional networks, media and platform amplification, and system-level responses, drawing on peer-reviewed studies and relevant review literature to identify recurring mechanisms and areas of convergence. This synthesis provides the structural foundation for the subsequent case-study and platform analyses.

2.2 Qualitative thematic synthesis

The second strand draws on secondary literature to construct two case framings: orchestrated discourses denying anthropogenic climate change, and the framing of climate policy as a threat to economic well-being and personal liberty. These framings were selected because they recur across the literature, capture distinct but complementary mechanisms of climate disinformation, and lend themselves to comparative analysis. Following Braun and Clarke (2006), we applied thematic analysis to the secondary literature associated with each framing, generating themes both deductively from existing conceptual work (notably Coan et al. 2021; Cook et al. 2018) and inductively from recurring patterns in the sources. The two cases are then interpreted through the Political, Economic, Social, Technological, Environmental, Legal (PESTEL) framework (Johnson et al. 2017), which provides a structured way to situate denialist discourses within their broader macro-environmental context.

2.3 Structured web of science search

The third strand consists of a structured WoSCC search to identify recent peer-reviewed evidence on how social and hybrid media contribute to the production and circulation of climate disinformation. For this strand, recent is defined as January 2019 through December 2025, the period shown in Fig. 1. The range begins in 2019, the year following the IPCC Special Report on Global Warming of 1.5 degrees Celsius, a moment that sharpened political and media attention to climate mitigation and, with it, the rhetorical and platform-based pushback that is the subject of this review. We focused on peer-reviewed journal articles in English that (i) addressed climate change or global warming, (ii) analyzed content on at least one social or hybrid media platform, and (iii) examined misinformation, disinformation, denial, or closely related constructs (e.g., “fake news”). The search proceeded in three steps.

First, we constructed a climate-specific query in the WoSCC Advanced Search interface to identify systematic reviews and meta-syntheses of climate (mis)information on social media: TI= (“social media”) AND TS=((“climat* chang*” OR “global warming” OR “climate crisis”) AND (misinformation OR disinformation OR “fake news” OR denial*)). This search returned 42 records. We prioritized reviews and meta-syntheses as our core evidence base because they aggregate findings across multiple primary studies and are recognized as the most robust form of evidence (Murad et al. 2016). Applying the “Review Article” filter using the search terms “systematic review” OR “scoping review” OR “meta-analysis” OR “meta-synthesis” yielded three eligible review-type papers (Essien 2025; Herasimenka et al. 2025; Vivion et al. 2024). That this specific, 2019 through 2025 search identified only three climate-focused syntheses is itself a substantive finding, underlining how little consolidated synthesis literature exists on climate disinformation in social media compared with the much larger general misinformation field.

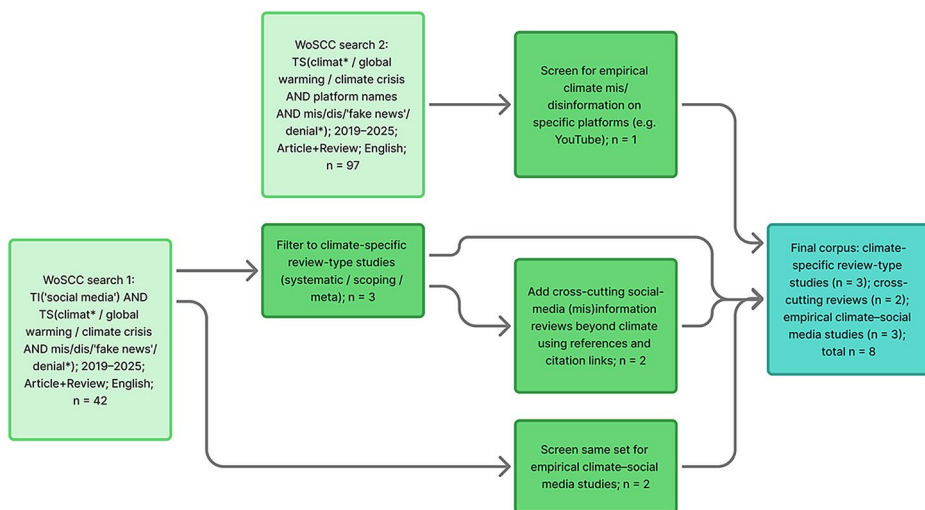


Fig. 1 Flow diagram of the triangulated paper-selection process for the media analysis (total $n=8$). Source: Authors' elaboration

Second, to situate the climate-specific evidence within the broader social-media misinformation ecosystem, we used WoSCC citation tools for backward and forward citation chasing, scanning reference lists, and using “Times Cited” and “Related Records” links to identify cross-cutting reviews that synthesized research on misinformation in social media irrespective of topic. From this pool, we selected two review papers that provided field-level mapping and typologies of mechanisms and interventions relevant to climate disinformation: a bibliometric review of 264 articles from 2010 to 2020 (Akram et al. 2022), and a scoping review of 75 psychological interventions countering misinformation in social media (Gwiażdziński et al. 2023).

Third, we identified recent empirical studies that analyzed climate-related disinformation on social media using large-scale or systematically sampled datasets. We returned to the original 42-record set and screened titles and abstracts for studies that focused substantively on climate change, climate policy, or the climate movement, analyzed content from at least one named social or hybrid media platform, and explicitly addressed misinformation, disinformation, denial narratives, or conspiracies. This screening yielded two eligible empirical studies: a clustering analysis of 333,635 tweets on anthropogenic climate change (Elroy et al. 2024), and a multi-platform analysis of over 20 million posts from Facebook, Instagram, Twitter, and YouTube (Storani et al. 2025). Because the initial query required “social media” in the article title, it did not capture studies whose titles referenced specific platforms only. To address this, we conducted a supplementary platform-specific WoSCC search: TS=((“climat* chang*” OR “global warming” OR “climate crisis”) AND (YouTube OR Twitter OR “X.com” OR Facebook OR TikTok OR Instagram) AND (misinformation OR disinformation OR “fake news” OR denial*)). Screening of this set identified one additional information-rich empirical study: a thematic analysis of climate misinformation within a YouTube “alternative influence network” centered on Spain’s Vox party (de Nadal 2024).

Together, these three steps yielded a focused evidence base of eight studies. The triangulated paper-selection process is shown in Fig. 1, and the included studies and their findings are summarized in Table 3.

3 Results

The results are organized in three subsections, corresponding to the strands of analysis described in the methods. Section 3.1 synthesizes the recent peer-reviewed literature on climate disinformation, organizing findings around four interrelated claims about funding, networks and platforms, message-level interventions, and the geographic concentration of evidence. Section 3.2 presents two thematic case syntheses: denialist discourse and the framing of climate policy as a threat to economic well-being and freedom, interpreted through the PESTEL framework. Section 3.3 reports a focused Web of Science synthesis of eight studies on platform mechanisms of climate disinformation and the democratic and epistemic harm they produce.

3.1 Review of literature identifying leading research in the field

The literature since 2018 has moved from catalogs of false claims to an interrogation of the structures that produce and sustain doubt. This section synthesizes recent research around four interrelated claims: organized funding sustains durability, networks and platform affordances amplify frames, message-level remedies require system-level complements, and the empirical evidence base remains geographically skewed toward the Global North.

Funding and the political economy matter. Several robust empirical studies, such as Brulle et al. (2021) and Gertrudix et al. (2024), show that disinformation should be treated as an organizational problem, not merely a messaging problem. Large but often opaque philanthropic flows and corporate support provide recurring resources to organizations that lobby, litigate, and place content over many years. These funds are not incidental. They enable institutional continuity, legal resilience, and sustained media access in ways that single message corrections cannot match (Brulle et al. 2021). The policy implication repeatedly proffered in recent research is clear: disclosure and fiscal accountability must be part of any effective countermeasure portfolio. Brulle et al.'s analysis is methodologically notable for combining funding-trace methods with institutional mapping, illustrating how actor types and funding sources can be systematically traced.

Networks and platform affordances turn sparse claims into social doubt. Mixed-methods network studies and platform analyses show coordinated seeding, selective citation of pseudo-science, and algorithmic prioritization operating together to simulate contested expertise. Recent experiments and field studies show how these networked signals interact with platform recommendation systems to broaden reach far beyond originating nodes (Sankaranarayanan et al. 2025). Counting messages is insufficient; structural amplification matters more: who funds content, which organizations seed it, and which accounts or outlets act as bridges across media ecologies (Brulle et al. 2021; Farrell 2016; Shao et al. 2018). Several studies use network analysis to map how actors interlink across platforms and identify amplifier nodes with high centrality measures (Bruns 2012; Freelon 2018), suggesting that future empirical work should prioritize amplifier nodes and tie strength rather than raw message counts.

Psychological interventions show promise but have limits when deployed alone. Experimental evidence shows that inoculation, prebunking, and consensus messaging produce measurable and sometimes long-lasting resistance to subsequent misrepresentation (Christner et al. 2024; Maertens et al. 2020; van der Linden 2024). These findings are methodologically robust, using randomized designs and retention checks. Yet systematic reviews and comparative analyses warn that effect sizes shrink when platform economics and funding opacity remain unchanged. In plain terms, inoculation buys time but does not dismantle the supply chain of falsehoods. This is a central point of scholarly convergence: message-level interventions are most effective when combined with transparency rules and platform governance.

The literature is geographically biased, and this influences conclusions. Most rigorous empirical research originates in North America, Europe, and Australasia (Herasimenka et al. 2025; Vivion et al. 2024). This concentration is not incidental: comparative media research finds that organized climate skepticism and denial are disproportionately an Anglo-Saxon media phenomenon, most visible in the United Kingdom, the United States, and Australia, and comparatively marginal in press coverage in France, Germany, Brazil, China, and India

(Painter 2011). Cross-national survey evidence corroborates that the mechanisms identified in this review do not travel evenly: trust in information sources, rather than exposure to disinformation itself, is the strongest predictor of false climate beliefs across eight countries spanning high- and middle-income settings, and the relative weight of that predictor varies by country (Ejaz et al. 2025). In the United States specifically, organizational power and cultural resonance jointly determine which climate frames receive media visibility, showing that even within a single Anglophone context the funding and platform mechanisms described above interact with a particular national media culture rather than a generic one (Wetts 2023). Several recent scoping reviews flag the resulting bias and call for more research in Africa, Asia, and Latin America. Where research from the Global South exists, it suggests distinct pathways of circulation, in which social media, messaging apps, and informal blogs combine with variable formal climate literacy to make economic and liberty frames particularly potent (Heffernan 2024; UNESCO 2024). Recognizing this bias is important for interpreting the present synthesis, whose findings draw predominantly on Global North, and disproportionately Anglophone, evidence.

Overall, literature is improving in methodological rigor, but important weaknesses remain. Funding studies supply strong trace evidence, experimental research gives causal leverage on message effects, and network studies reveal amplification mechanics. Yet studies that combine funding traces, network topology, and content engagement across multiple platforms remain rare. Few papers integrate financial flows with platform mappings and message experiments in the same design (e.g., Gertrudix et al. (2024) and Lewandowsky (2021a)). That integration remains a priority for future empirical work. Table 1 summarizes leading studies and their primary foci. Together, these works supply the conceptual foundation for the case-study analysis and platform synthesis that follow.

The literature reviewed here points to a consistent argument: climate disinformation is sustained by opaque funding, institutional alliances, and platform dynamics rather than a series of isolated false claims. Funding provides organizational longevity, networks seed and legitimize doubt, and platform affordances amplify selected frames into widespread controversy. Across this evidence base, the literature identifies core rhetorical repertoires: economic threat, liberty frames, false certainty, and delegitimization of expertise, and emphasizes the role of humor, populist identity work, and targeted amplification. It also calls consistently for a combined response: message-level inoculation and media literacy alongside transparency, platform governance, and policy measures aimed at the funding and amplification chain.

3.2 Qualitative thematic analysis of selected climate disinformation case studies

3.2.1 Case study 1: Orchestrated discourses denying the occurrence of climate change

This case study synthesizes the literature on how organized actors construct and disseminate narratives that deny or downplay anthropogenic climate change. Such denialist discourses are not the outcome of individual error; the literature consistently characterizes them as purposeful, funded, and strategically deployed efforts that draw on political, cultural, and affective resources to manufacture doubt and slow policy responses. The synthesis below draws on rhetorical and discourse-analytic studies to show how these narratives mobilize emotional appeals, cultural identity markers, and populist idioms to strengthen group cohe-

sion and delegitimize scientific authority. It also examines the role of digital ecosystems, where influencers, algorithmic amplification, and forms of humor normalize skepticism and render denial socially acceptable across diverse cultural contexts. The synthesis is organized around seven recurring themes.

Predominant themes and rhetorical techniques. Denial campaigns use a stable repertoire of rhetorical devices designed to create doubt, delegitimize expertise, and entrench contrarian identities. These include claims of “no proof” and “junk science”; demands for impossible levels of certainty from models; cherry-picking of data; promotion of so-called fake experts; and conspiratorial framings. The literature reports that such techniques are often financed and coordinated to preserve the status quo, sustaining legal, media, and lobbying capacities that outlast episodic controversies (Brulle et al. 2021; Gwiazdon 2023). Studies document strategies of responsibility denial, delegitimization of climate advocates, and framing dissenters as victims of mainstream consensus, used to blunt accountability and contest dominant climate meanings (Monteiro Ramos and Castro 2025; Vallström and Törnberg 2025).

Narrative structures and emotional appeals across cultures. Denial narratives are carefully structured to avoid acknowledgment of loss or responsibility. They frequently separate discussion of catastrophic impacts from potential solutions, producing fragmented discourses with no clear protagonists and a defensive orientation (Bresolin 2023). Emotional strategies vary by context: humor, irony, and satire make skepticism palatable, while moralized vocabularies and appeals to tradition reinforce resistance. Comparative research finds variation in popular culture: some Chinese satirical forms foreground collective responses to immediate crises, whereas certain US cartoons politicize future risks and target institutional accountability (Zhao and Wu 2025). The common thread across these accounts is that narratives are calibrated to cultural values that make denial feel understandable or even righteous.

Populist rhetoric and group identity. Populist “us versus them” rhetoric is central to many denialist campaigns. Such rhetoric constructs an antagonistic boundary between ordinary people and elites, including scientists, and often draws on nationalism, nativism, or religious identity to mobilize opposition to climate action (Kulin and Johansson Sevä 2024; Rekker 2025). Masculine industrial identities and protection of economic privilege are frequently invoked. Authoritarian and far-right actors have used denial as a strategy to preserve hierarchical power relations (Gwiazdon 2023; Swan 2025). These identity constructions are highly context-dependent and vary in form and intensity across national settings.

Role of online influencers and platform algorithms. Digital platforms and influencers serve as vectors for amplifying denial narratives. Political actors, sympathetic media outlets, and prominent influencers seed claims that are then amplified by reposting, hyperlinking, and algorithmic recommendations (Gounaridis and Newell 2024; Sankaranarayanan et al. 2025; Vallström and Törnberg 2025). Platform affordances: targeted ad delivery; both activity and recommendation systems can concentrate exposure in specific audiences, particularly among right-wing constituencies (Sankaranarayanan et al. 2025). Multimodal communication strategies combining text, video, and memes contribute to perceived legitimacy (Rojas et al. 2024; Vécsey 2025).

Psychological and cultural defense mechanisms. Denial operates at individual and collective psychological levels, serving defensive functions such as the avoidance of guilt or anxiety. Mechanisms like splitting and projection create polarized representations that

protect group identity (Gagnon et al. 2022). Cultural orientations, including individualism versus collectivism, environmental identity, and social dominance, influence how denial manifests and is received (Chen 2025; Nartova-Bochaver et al. 2022). In regions experiencing acute climate impacts, denial can also function palliatively, reducing immediate anxiety (Hadarics 2021).

Humor, irony, and social acceptability. Humor and irony render denial less confrontational and more socially acceptable. Satirical cartoons, ironic markers, and aggressive humor can normalize skeptical positions and facilitate recruitment into contrarian communities (Cook et al. 2023; Gal et al. 2022; Vécsey 2025). Empirical research suggests these tactics can increase certainty among non-believers and lower perceptions of risk, shaping social attitudes over time.

Populist moral landscapes and identity construction. Populist moral framings shape how in-group and out-group identities are formed, with considerable variation by country. Religious, national, and historical narratives are repurposed to defend existing economic and social arrangements, producing episodic backlash against climate measures (Biancalana et al. 2025; Yazar 2024). At the same time, there is space for alternative moral repertoires: green populism and climate justice movements that construct counter-identities and challenge mainstream denialist discourses (Agustín and Jerne 2025; Meyer 2024).

3.2.2 Case study 2: Framing climate policy as a threat to economic well-being and freedom

In the climate obstruction typology introduced above, this case corresponds closely to delay: the acceptance of climate science paired with resistance to specific policy responses (Lamb et al. 2020). This case study synthesizes the literature on how climate policy is framed rhetorically as an existential threat to economic prosperity, personal liberty, and national sovereignty. Such framings draw on neoliberal and libertarian traditions in which market freedom, property rights, and minimal state intervention are presented as moral imperatives. The synthesis examines how economic threat narratives are adapted to different social groups, from rural communities to international elites, and how they intersect with populist politics to deepen polarization. The synthesis is organized around six recurring aspects.

Economic and libertarian threat narratives. Economic threat frames depict climate policy as likely to reduce growth, cause job losses, and raise living costs, resonating with immediate material concerns (Gwiazdon 2023; Irwin 2025; Lewandowsky 2021b). Libertarian framings present policy as government overreach that infringes individual and property rights; these messages are leveraged by right-wing actors to link climate action with threats to national sovereignty (Dickson and Hobolt 2025; Kulin and Johansson Sevä 2024).

Tailoring frames to vulnerable populations. Economic threat narratives are often tailored to exploit existing inequalities. Messages that emphasize job losses or rising costs gain traction among economically vulnerable groups, who may prioritize short-term survival over long-term climate risk (Paniello-Castillo et al. 2025). Intersectional factors such as race and income further affect receptivity (Paniello-Castillo et al. 2025).

Right-wing actors and polarization. Right-wing political actors use digital platforms and corporate resources to amplify economic and freedom threat frames, polarizing debate. Think tanks and organized political movements disseminate technical and ideological

content that generates high engagement and influences policy discourse (Gwiazdon 2023; Moreno-Cabanillas et al. 2024).

Neoliberal market logics and dissemination. Neoliberal frames shift responsibility onto consumers and downplay corporate accountability, recasting climate action as a market problem rather than a regulatory necessity (Pathak 2023). Hybrid narratives that combine market solutions with skeptical rhetoric complicate public understanding and enable selective mobilization via social media (Essien 2025; Vasist et al. 2024).

Property rights and freedom from a comparative perspective. Libertarian appeals are particularly salient in the United States, where property rights and constitutional arguments are invoked to resist policy. In Europe, debate tends to focus more on regulatory adaptation and legal instruments for land use, even as concerns about economic impact persist (Goldstein and Hudak 2017; McIntosh and Hatcher 2016). Comparative literature reveals important divergences in how freedom and property are mobilized in climate discourse, reinforcing the need for context-sensitive responses. Table 2 summarizes the comparative thematic analysis of the two case studies.

The PESTEL framework provides a structured way to interpret the macro factors that shape public contestation over climate science. Applied to climate change denial, the framework helps integrate the case-study findings, showing that denial is not a single error or an isolated story; it is a distributed, politically charged phenomenon that draws strength from interactions among institutions, markets, cultures, and technologies.

Politically, denialist rhetoric is woven into processes of polarization. Right-wing actors and populist movements often exploit skepticism about climate science to mobilize supporters, cast doubt on regulatory proposals, and stall policy reform. Economically, denial narratives are framed as defenses of jobs, markets, and prosperity; they rehearse libertarian anxieties about state overreach and present mitigation as an unaffordable burden. Socially, identity and moral economy matter: in-group narratives, religious or regional loyalties, and gendered occupational identities can make rejection of climate policy feel not only rational but morally right.

Technological forces amplify these processes. Algorithmic recommendation, targeted advertising, and influencer economies concentrate exposure in like-minded networks, turn-

Table 2 Qualitative thematic analysis of climate change disinformation case studies

Theme / Case Study	Predominant Narratives	Rhetorical Techniques	Emotional Appeals	Dissemination Strategies	Key Actors	Regional Variations
Denial of Climate Change Occurrence	“No proof”, “Junk science”, Conspiracy, FLICC	Delegitimization, Fake experts, Humor, Irony, Populist “us vs. them.”	Stigmatization, Group identity, Humor, Irony	Social media amplification, Influencer networks, Bots	Corporate, Political, Academic, Online influencers	US, Europe, Brazil, China, Russia, India
Framing Climate Policy as Economic / Freedom Threat	Economic burden, Loss of jobs, Threat to personal freedom, Libertarian/ Free-market	Binary oppositions, Conspiratorial, Nationalist rhetoric	Fear, Victimhood, Economic insecurity	Social media, Traditional media, Pseudo-media, Think tanks	Right-wing political actors, Corporate interests, Fossil fuel front groups	US, Europe, Global South (urban/ rural)

ing a few seeded claims into apparently widespread controversy. Environmentally, the consequences are severe: the PESTEL interactions normalize doubt, slow collective responses, and legitimize inaction in ways that compound physical risks. Legally, narratives invoking property rights and personal liberty, particularly potent in the United States and parts of Europe, portray regulation as an infringement on individual freedoms, reframing public debate in constitutional rather than scientific terms.

The PESTEL view, applied across the two case studies, shows climate denial as a coordinated system of meaning sustained by political incentives, economic interests, social identities, technological affordances, environmental consequences, and legal framings. Understanding these interdependencies is essential if interventions are to move beyond correcting individual claims toward addressing the structural sources that produce and amplify disinformation (Fig. 2).

3.3 Platform mechanisms of climate disinformation

The structured Web of Science search yielded eight studies that together map how social and hybrid media foster climate disinformation, erode trust, and obstruct climate action. The included studies, their main empirical findings, and the mechanisms they identify are summarized in Table 3.

Across the eight studies, social and hybrid media emerge as core infrastructures through which climate disinformation is produced, disseminated, and normalized. Synthesized evidence shows that climate disinformation “represents not only a collection of false claims but also a broader epistemic issue sustained by digital environments, power structures, and fossil corporations” (Essien 2025, p.1), undermining citizens’ epistemic welfare and general trust in scientific expertise. Disinformation actors exploit cognitive vulnerabilities: emotional appeals, micro-targeting, and low critical social media literacy to trap users in skewed information diets and conspiracy-laden narratives, polarizing debate and weakening support for evidence-based climate policy (Akram et al. 2022). Large-scale analyses reveal that unreliable climate sources constitute a small fraction of posts yet “receive, on average, higher engagement than content linked to reliable sources” (Storani et al. 2025) (p. 7), indicating that engagement-driven algorithms systematically privilege sensationalist and misleading material. Qualitative research on YouTube documents a shift from overt denial

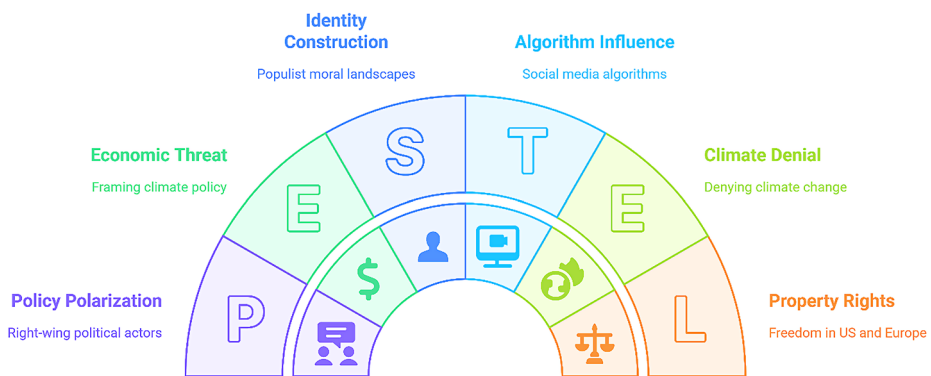


Fig. 2 Climate change denial PESTEL analysis. Source: Authors’ elaboration

Table 3 Platform mechanisms and democratic harms of climate disinformation

Key Theme	Concise Summary of Main Empirical Finding	Mechanism Undermining Democracy / Climate Action / Climate Science	References
Climate disinformation erodes epistemic welfare	Meta-synthesis of 38 studies shows that climate disinformation on social and hybrid media is produced at the intersection of vested interests, partisan actors, and digital infrastructures, and “represents not only a collection of false claims but also a broader epistemic issue sustained by digital environments, power structures, and fossil corporations” (p. 1).	Epistemic overload and distrust: continual exposure to conflicting claims and conspiracy frames normalizes doubt, weakens trust in scientific and journalistic institutions, and makes publics more receptive to anti-climate actors who present themselves as alternative truth-tellers.	(Essien 2025)
Sparse evidence on effective resistance	Systematic review of 38 studies on manipulative climate information on social media shows that responses overwhelmingly emphasize “corrective information sharing and education campaigns targeting media literacy” (p. 2), while highlighting opportunities for future studies to experimentally test interventional approaches, including in non-English-speaking contexts.	Manipulation spaces remain widely unaddressed; until interventions are rigorously tested and mainstreamed at scale in real platform ecologies, powerful actors can continue to exploit weakly regulated environments to influence public agendas and slow ambitious climate policy.	(Herasimenka et al. 2025)
Mapping the climate infodemic / mis/dis-info evidence base	This protocol sets out a scoping review to “assess the current state of knowledge about misinformation concerning climate change and related environmental events that are circulating on social media” (p. 1) by systematically charting themes, actors, sources, platforms, and geographical contexts (with particular attention to Canada) across peer-reviewed and grey literature from 2000 onwards.	Underdeveloped governance capacity weakens action; by consolidating fragmented findings on how climate misinformation polarizes publics, the review is designed to equip regulators with a more precise knowledge base for targeted and democratically legitimate responses, rather than ad hoc or purely reactive content takedowns.	(Vivion et al. 2024)
Disinformation exploits cognitive vulnerabilities	Bibliometric review of 264 WoSCC articles (2010–2020) on disinformation through social media shows a post-2017 rise in research. It identifies “five psychosocial and political factors”: influencing users’ perceptions, providing easy access to radicalism via personality profiles, using social media to influence political opinions, lack of critical social media literacies, and the proliferation of hoaxes that help disinformation flourish (p. 1).	Through exploiting emotional appeals, micro-targeting (tailoring messages narrowly to individuals), and low critical media literacy, social-media disinformation traps users in skewed information diets and conspiracy-laden narratives, polarizing public debate, undermining trust in scientific and democratic institutions, and weakening support for evidence-based climate policy.	(Akram et al. 2022)

Table 3 (continued)

Key Theme	Concise Summary of Main Empirical Finding	Mechanism Undermining Democracy / Climate Action / Climate Science	References
Interventions are under-tested in real platforms	Scoping review of 75 studies on psychological interventions against social-media misinformation groups strategies into boosting, technocognition, and nudging; “most of the studied interventions were not implemented and tested in a real social media environment” and instead used controlled or crowdsourcing settings (p. 1).	Because promising tools such as source rating are rarely implemented on platforms, mainstream feeds continue to privilege emotionally charged, misleading content, reinforcing polarization and distrust that spill over into climate debates and weaken support for collective climate action.	(Gwiazdziński et al. 2023)
Conspiracy-laden Twitter climate narratives	Analysis of 333,635 English-language tweets on anthropogenic climate change identifies four narrative clusters (Anthropogenic, Scientific, Policy, Conspiracy); the Conspiracy cluster is the smallest but relies heavily on URLs and repeatedly cites user-generated sites and known climate-denialist authors (e.g., Tim Ball, Patrick Moore) to question human causation and cast climate policy as a “hoax” (p. 4).	Echo chambers and conspiracy frames funnel users into mixed-attitude communities where conspiracy content and denialist links circulate as seemingly credible evidence; the cluster normalizes rejection of anthropogenic climate change, erodes trust in public institutions, and proffers excuses to resist mitigation and adaptation measures.	(Elroy et al. 2024)
Unreliable sources gain more engagement	Multi-platform analysis of 21.6 million climate-related posts (p. 3) on Facebook, Instagram, Twitter/X and YouTube (2018–2022) finds that content linking to domains rated as unreliable makes up only about 7% of posts (p. 8), yet “unreliable sources receive, on average, higher engagement than content linked to reliable sources” (p. 7), with unreliable content attracting around 1.2 times the engagement of reliable content (p. 8).	Because platform designs and user behavior reward sensationalist, controversial narratives, misleading climate content from unreliable sources is algorithmically surfaced and interacted with more often, crowding out reliable information, deepening polarization and confusion, and weakening shared support for evidence-based climate policy.	(Storani et al. 2025)
YouTube ‘post-denial’ culture-war narratives	Thematic analysis of 36 climate-related videos from 11 YouTube political influencer channels in a Vox-aligned “Alternative Influence Network” finds almost no outright denial; instead, influencers adopt “post-denial” narratives that accept climate change but attack Net Zero, climate policies, and activists through conspiracy theories, anti-“woke” rhetoric, and misogynistic portrayals, folding climate into a wider culture war.	Through recasting climate policy as an elitist, authoritarian, and anti-national “woke” project, these channels mobilize resentment (especially among young men), delegitimize democratic climate institutions, and normalize obstruction of mitigation measures, while sidestepping the reputational costs of openly rejecting climate science.	(de Nadal 2024)

toward “post-denial” culture-war narratives that accept basic climate science while attacking Net Zero, climate policies, and activists, reframing climate action as an elite or “woke” project and eroding democratic legitimacy (de Nadal 2024). At the same time, the sampled review literature underscores how little is known about what actually works: most proposed

countermeasures have not been tested in real social-media environments, and robust guidance for fair, proportionate regulation is only slowly emerging. This evidence base strengthens calls for public education to build critical social media literacy, better data access for researchers, and structural platform reforms to protect democratic processes and sustain trust in climate science as a basis for legitimate knowledge production (Akram et al. 2022; Gwiazdziński et al. 2023; Herasimenka et al. 2025; Vivion et al. 2024).

4 Discussion

Taken together, the three strands of this review point toward a consistent picture of climate disinformation as a layered, structurally sustained phenomenon rather than a series of isolated falsehoods. The literature review (Sect. 3.1) shows that climate disinformation is underwritten by organized funding, networked amplification, and a relative shortage of system-level countermeasures. The case syntheses and PESTEL interpretation (Sect. 3.2) show how these structural drivers manifest at the level of rhetoric and identity: denialist discourses mobilize emotional, populist, and cultural resources to make doubt feel familiar, while economic and liberty framings recast climate policy as a threat to prosperity and freedom. The platform synthesis (Sect. 3.3) shows that these framings travel through social and hybrid media in ways that reward sensationalism, concentrate exposure within ideologically aligned audiences, and increasingly take the form of “post-denial” culture-war narratives that accept basic climate science while attacking climate policy.

What none of the three strands shows on its own is how these layers reinforce each other. Funding sustains the organizations that develop rhetorical repertoires; rhetorical repertoires furnish content that platforms then amplify; platform incentives reward the most emotionally charged versions of those repertoires, which in turn justify further investment in their production. The result is a system in which message-level corrections, however well designed, address only one segment of a self-reinforcing cycle. Inoculation, prebunking, and consensus messaging can build short-term resistance to specific claims, but they do not interrupt the structural processes that continuously generate new claims, repackaging them for new audiences, and circulate them through algorithmically rewarded channels.

This integrated reading also helps explain why the field’s most rigorous countermeasure research can show real effects in experimental settings even as public discourse on climate appears to remain polarized and resistant to correction. Experimental designs isolate the message-level layer; the political-economic and platform-mechanical layers remain unchanged in the world the participants return to after the experiment ends. The evidence converges on the conclusion that climate disinformation is durable not because any single mechanism is powerful, but because political-economic, rhetorical, and platform mechanisms reinforce each other. The integrated picture has direct implications for how interventions should be designed and combined. Message-level interventions remain necessary. The experimental literature provides robust evidence that inoculation, prebunking, and consensus messaging produce measurable resistance to disinformation, and these tools deserve a continuing place in any countermeasure portfolio. However, the review’s three strands together suggest that message-level work is most useful when nested within wider structural reforms.

At the political-economic level, transparency about the funding of advocacy organizations, think tanks, and political advertising would reduce the strategic value of opaque

influence channels and make the supply side of disinformation legible to the public and regulators. At the platform level, structural reforms that change the incentives of recommendation systems, including better data access for independent researchers, clearer rules on engagement-driven amplification of unreliable sources, and proportionate content governance for coordinated manipulation, would reduce the structural amplification on which contemporary climate disinformation depends. At the educational level, media and information literacy programs that build critical engagement with social media specifically, rather than information generally, can complement message-level interventions by equipping audiences to recognize the rhetorical and platform mechanics they routinely encounter.

The two layers should not be treated as substitutes. Message-level interventions without structural reform face the problem just described: effects shrink when the environment that produces disinformation is unchanged. Structural reforms without message-level work leave the cognitive vulnerabilities that disinformation exploits unaddressed. The integrated picture argues for combined, coordinated action across all three levels, recognizing that climate disinformation operates as a system, and effective response requires addressing it as one.

Finally, several limitations should be acknowledged. The review synthesizes secondary literature rather than generating new empirical evidence, and its conclusions are therefore conditional on the strengths and weaknesses of the source studies. The structured Web of Science search yielded eight studies on platform mechanisms, a small number that reflects the relative youth of the field rather than a comprehensive evidence base. The case syntheses draw on a broad but uneven literature in which some framings are studied more frequently than others. The reliance on English-language sources and on databases indexed by Web of Science further narrows the evidence available to this synthesis. The evidence base itself is also geographically skewed. Most rigorous empirical research on climate disinformation originates in North America, Europe, and Australasia, while research on the Global South, where information ecologies, platform usage patterns, and trust dynamics differ markedly, remains comparatively sparse. The findings reported here should therefore be read as drawn predominantly from Global North evidence, and their applicability to other contexts requires further empirical work.

The integrated reading developed here suggests several priorities for future empirical work. First, studies that combine funding-trace methods, network analysis, and content engagement measurement within a single design remain rare. Nevertheless, they are precisely what is needed to test the interactions between the political-economic, rhetorical, and platform layers identified in this review. Second, intervention research would benefit from moving beyond controlled experimental settings into real platform environments, where the message-level effects observed in laboratory studies can be tested against the structural conditions that may attenuate them. Third, comparative research across regions, particularly research that examines how the framings and mechanisms documented in Global North contexts circulate, mutate, or fail to take hold in Global South information ecologies, would correct the geographic bias of the present evidence base and clarify which mechanisms generalize and which are context-specific. Fourth, longitudinal research on the recent shift from overt denial to “post-denial” culture-war framings would help clarify whether this represents a strategic adaptation by disinformation actors, an organic shift in audience preferences, or some interaction of the two. Such work could also clarify whether the observed

shift represents a broader transformation in climate obstruction, from overt denial toward delay and distraction strategies (Lamb et al. 2020; Roberts et al. 2025).

5 Conclusion

Across its three strands, this review argues that climate disinformation is best understood not as a series of falsehoods to be corrected one at a time but as a layered, structurally sustained phenomenon in which political-economic, rhetorical, and platform-mechanical processes reinforce each other. The literature synthesis identifies the funders and organizations that provide durability; the case syntheses show the rhetorical repertoires through which doubt is made socially acceptable within their broader contextual environment; the platform synthesis shows the engagement-driven mechanics that amplify those repertoires and increasingly translate denial into culture-war framings.

The central implication of this study is that countermeasures designed for any single layer will be insufficient on their own. Message-level interventions such as inoculation and consensus messaging remain valuable, but their effects are attenuated when the funding networks, rhetorical infrastructures, and platform incentives that produce disinformation remain unchanged. A response proportionate to the problem will combine cognitive protection with transparency in advocacy funding and structural reform of platform amplification, treating climate disinformation as a system rather than a sequence of claims.

The integration developed here is offered as a step toward that reframing. Whether the layered account presented in this review holds across different regions, languages, and media environments, and how the interactions between its layers might be measured in a single empirical design, are questions that the present synthesis cannot answer but that future research is well placed to address.

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