A Systems Mapping Approach to Populist Climate Obstruction: Knowledge Integration and Future Applications in Deep Renovation

Christoph Schünemann[1,*], Zadekia Krondorfer[2], Maria Pierce[3,4]

[1]Leibniz Institute of Ecological Urban and Regional Development
Weberplatz 1, 01217 Dresden, Germany

[2] Hannah Arendt Institute for Totalitarianism Studies,

Helmholtzstraße 6, 01069 Dresden, Germany

[3] Thünen Institute of Baltic Sea Fisheries,
Alter Hafen Süd 2, 18069 Rostock, Germany

[4]Institute for Visual and Analytic Computing, University of Rostock,
Albert-Einstein-Straße 22, Rostock, Germany

* Corresponding author: c.schuenemann@ioer.de, ORCID: 0000-0002-1214-8593

Abstract

Research across political science, sociology, psychology, and economics increasingly examines how populism may undermine climate action. However, these literatures employ different concepts, theoretical traditions, and analytical frameworks, making interdisciplinary comparison and knowledge integration difficult. At the same time, the phenomenon is widely understood to emerge from interacting dynamics spanning individual, societal, political, and economic domains.

This study addresses these challenges by introducing populist climate obstruction as an interdisciplinary umbrella concept and exploring systems mapping as a knowledge-integration approach. Drawing on Systems Thinking, we develop a first draft of a Causal Loop Diagram (CLD) representing potential feedback structures underlying populist climate obstruction. The system map was developed through a synthesis of relevant literature and the disciplinary expertise of the authors. The study distinguishes between interdisciplinary knowledge integration among scientific disciplines and stakeholder-oriented knowledge integration involving actors who shape, implement, or are affected by climate policy.

Rather than providing a validated representation of the phenomenon, the CLD is intended as a preliminary boundary object that makes assumptions, variables, and causal relationships explicit and open to discussion. The model highlights how processes related to political polarisation, trust, social norms, climate attitudes, and socio-economic insecurity may interact through reinforcing and balancing feedback structures. Deep renovation of the residential building stock is discussed as a particularly promising case for future stakeholder-based application and validation, given its complexity, heterogeneous decision contexts, and political contestation. More broadly, the study demonstrates how visual systems mapping can support interdisciplinary and stakeholder-oriented knowledge integration. Future work will focus on participatory validation and refinement through Group Model Building processes.

Keywords

climate obstruction; populism; climate politics; systems mapping; knowledge integration

1. Introduction

Across multiple disciplines, including political science, sociology, social psychology, and economics, a growing body of scholarship examines how populism undermines climate action. Climate obstruction is commonly defined as the intentional action or effort to slow or block climate policies commensurate with the current scientific consensus (Roberts et al., 2025). This literature frequently identifies populist actors, narratives, and movements as part of the broader landscape in which obstruction unfolds. Populism research, in turn, has been variously theorised as an ideology, discursive logic, performative style, or political strategy (Laclau, 2005; Moffitt, 2016; Mudde & Kaltwasser, 2017; Weyland, 2001), and has increasingly examined its relationship to climate politics, particularly in the context of climate scepticism and resistance to climate policy (Forchtner, 2019; Lockwood, 2018). Yet, the relationship between populism and climate politics is neither inherently obstructive nor confined to the far right: eco-populist movements may mobilise populist logics in support of climate action, while certain strands of far-right ecologism complicate a straightforward equation of right-wing populism with climate scepticism.

We therefore define populist climate obstruction as forms of climate obstruction that operate through populist narratives, logics, or political strategies. It encompasses practices such as framing climate politics as a conflict between "the people" and "the elite", simplifying or emotionalising climate-related issues, or promoting allegedly simple solutions to complex societal challenges in ways that contribute to slowing, blocking, delegitimising, or hollowing out climate policies consistent with the current scientific consensus on climate action.

Research on populist climate obstruction is dispersed across different disciplines and theoretical traditions, reflecting the contested nature of both populism and climate politics (Marquardt & Lederer, 2022). Political scientists have traced how populist anti-elitism systematically produces climate scepticism and hostility to science-aligned policy-making (Huber, 2013; Lockwood, 2018). Sociologists have shown how organised counter-movements mobilise the same anti-elitism to institutionalise denial and normalise inaction (Brulle, 2014; Dunlap & McCright, 2015). Social and environmental psychologists have examined how climate attitudes, self-efficacy, emotions, and climate anxiety shape responses to climate action and climate politics (Sangervo et al., 2022). Economists have highlighted the importance of distributional grievances, perceived climate-policy costs, and fossil-dependent material interests (Bosetti et al., 2025). Together, these traditions capture important dimensions of the phenomenon and explain its causes and interdependencies through different theoretical and epistemological frameworks.

At the same time, these literatures increasingly acknowledge that populist climate obstruction cannot be understood within a single domain (Ekberg et al., 2023). Rather, it emerges from interactions between individual attitudes and perceptions, societal norms and identities, political institutions and governance processes, and economic interests and distributional conflicts. Despite this recognition, our literature review revealed no systemic framework that integrates these perspectives and their feedback relationships into a shared analytical representation. Consequently, interdisciplinary comparison, knowledge integration, and the development of a more holistic understanding remain challenging.

Approaches from Systems Thinking offer promising tools to address this challenge. Co-developing visual systems maps, for example through Group Model Building (Vennix, 1996), has proven effective for integrating inter- and transdisciplinary knowledge across different disciplines and epistemological traditions (Hovmand, 2014; Stepanova et al., 2020). Such visual representations can function as boundary objects that make assumptions, variables, and causal relationships explicit and thereby support dialogue, critique, and structured knowledge integration among researchers with different disciplinary backgrounds. Importantly, interdisciplinary and stakeholder-oriented knowledge integration address related but distinct challenges: the former concerns the integration of theories, concepts, empirical findings, and causal assumptions across scientific disciplines, whereas the latter brings scientific perspectives into dialogue with experiential, practical, institutional, and political knowledge held by actors involved in or affected by transformation processes.

This article contributes to this emerging discussion by introducing a first draft of a Causal Loop Diagram (CLD) (Sterman, 2002; Veldhuis et al., 2025) representing the feedback structures through which populist climate obstruction may emerge and reinforce itself across individual, societal, political, and economic dimensions. The CLD presented here is neither complete nor empirically validated. Rather than providing a definitive representation of the phenomenon, it constitutes an initial synthesis based on the reviewed literature and the disciplinary expertise of the authors. Its primary purpose is to serve as a boundary object and starting point for interdisciplinary dialogue, critique, and future Group Model Building processes involving scholars from different disciplines. Through iterative extension, revision, and validation, the CLD is intended to support the development of a more comprehensive systems understanding of populist climate obstruction. The present study focuses on the first of these forms of integration, while positioning stakeholder-oriented validation as a complementary next step.

The paper therefore asks how systems mapping can integrate different disciplinary perspectives on populist climate obstruction and provide a basis for subsequently examining how these systemic hypotheses are interpreted, challenged, or extended by relevant stakeholders. Deep renovation is used not as a separate modelling target in the present study, but as a promising empirical context for this next step because it combines high system complexity, heterogeneous decision contexts, and pronounced political contestation.

2. Methods

2.1. Knowledge integration and systems mapping

In interdisciplinary research, knowledge integration across disciplinary boundaries is often challenging because researchers draw on different theoretical traditions, methodological approaches, and epistemological assumptions (Stepanova et al., 2020). These differences become particularly visible when addressing complex societal phenomena such as populist climate obstruction, which involves interacting individual, societal, political, and economic processes. While individual disciplines provide valuable insights into specific mechanisms, they often conceptualise key variables, causal relationships, and system boundaries differently.

The objective of this study is therefore not only to describe populist climate obstruction, but also to explore how knowledge from different disciplines can be integrated into a shared systems representation. Approaches from Systems Thinking (Best & Holmes, 2010; Boardman & Sauser, 2013) offer useful tools for this purpose. In particular, visual systems maps can function as boundary objects that facilitate communication between researchers with different disciplinary backgrounds by making assumptions, variables, and causal relationships explicit (Black, 2013). In this paper, these participatory principles are considered in two analytically distinct directions. Interdisciplinary integration concerns negotiation among scientific disciplines over concepts, causal assumptions, and system boundaries. Stakeholder-oriented or transdisciplinary integration additionally involves actors from policy, practice, and affected groups whose experiential, institutional, or political knowledge may challenge or extend the scientific representation. The present CLD addresses the former; the latter is identified as a subsequent validation and development step.

The approach draws on principles of participatory systems modelling, which seeks to integrate diverse forms of knowledge through the collaborative development of system representations (Scott, 2018). Group Model Building (Hovmand, 2014; Vennix, 1996) represents one established approach within this broader tradition and provides important inspiration for the future development and validation of the CLD draft. In such processes, participants contribute their disciplinary mental models, negotiate meanings of variables, discuss causal assumptions, and jointly develop a shared representation of the system. The identification and definition of variables itself is expected to constitute an important interdisciplinary challenge, as concepts such as trust, social norms, climate attitudes, fairness, or political acceptance are often understood differently across disciplines. Rather than eliminating these differences, systems mapping provides a structured environment for making them visible and integrating them into a shared analytical framework.

Beyond system description, systems maps can also support the identification of potential leverage points for intervention (Abson et al., 2017; Meadows & Wright, 2011). By making feedback structures visible, they help

researchers explore where interventions may influence broader system dynamics and where unintended consequences may emerge.

2.2. Causal Loop Diagrams

From the toolbox of qualitative systems mapping approaches, we selected CLDs as the primary modelling method. A CLD is a visual representation of a complex system that focuses on causal relationships and feedback structures among variables (Sterman, 2002). System variables are connected through causal links indicating whether a change in one variable tends to produce a change in the same direction (+) or in the opposite direction (-) in another variable. When causal links form closed chains, feedback loops emerge. Reinforcing feedback loops amplify ongoing system developments destabilising the system, whereas balancing feedback loops counteract change and contribute to system stability. The interaction of multiple feedback loops can generate complex, path-dependent, and often non-linear system behaviour. CLDs therefore support the exploration of dynamic hypotheses about how a phenomenon may emerge, persist, or change over time.

An important feature of system dynamics modelling are delays between causes and effects. Delays often influence the behaviour of social and political systems by creating temporal gaps between interventions and observable outcomes. Although delays are not explicitly represented in the current version of the CLD, their systematic incorporation is planned in future iterations as part of the model refinement and validation process.

2.3. Development of the preliminary CLD

The presented first draft of the CLD was developed iteratively by the three authors through a series of discussions and virtual workshops. The model draws on existing literature and the authors' disciplinary expertise in political populism, climate politics, climate economics, behavioural and environmental psychology, and related fields. The resulting diagram should not be interpreted as a validated representation of the real-world system. Rather, it represents an initial synthesis of current knowledge and serves as a starting point for future interdisciplinary refinement.

The CLD was deliberately designed to prioritise accessibility, transparency, and discussion. In contrast to highly detailed system dynamics models, the number of variables and relationships was intentionally limited to maintain explainability and support communication across disciplinary communities (Ghaffarzadegan et al., 2011). Furthermore, some conventional CLD design principles (Sterman, 2002) were adapted to enhance readability for audiences unfamiliar with systems modelling. In this sense, the diagram is intended to function primarily as a boundary object that supports critique, extension, and collaborative model development rather than as a final analytical product.

The ultimate objective is to develop a more comprehensive systemic understanding of populist climate obstruction that integrates insights from different disciplinary perspectives and supports the identification of effective intervention and leverage points.

3. First results

3.1. Variable identification as a knowledge integration challenge

Before analysing feedback structures, interdisciplinary systems mapping faces a more fundamental challenge: agreeing on the meaning, system location, and causal role of key variables. Concepts that appear straightforward at first sight may carry different meanings across disciplinary traditions. As a result, variable identification is not merely a technical modelling step but a central process of knowledge integration.

The variable “pro-climate social norm”, which is used in the CLD and introduced below, illustrates this challenge. Researchers from different disciplines may use the same term while referring to different underlying mechanisms, levels of analysis, or causal assumptions. These differences influence not only how a variable is defined but also how it is connected to other variables within the system. Consequently, disagreements may

emerge regarding whether a variable should be located primarily at the individual, societal, political, or economic level, as well as regarding the mechanisms through which it influences behaviour and climate-related outcomes.

Table 1 provides an illustrative overview of how selected disciplinary perspectives may conceptualise the variable "pro-climate social norm" and the implications this has for systems mapping. The examples are derived from representative introductory and review sources and are intended to demonstrate how researchers from different disciplinary traditions may assign different meanings, causal roles, and system locations to the same system variable. Such differences are important because they influence how variables are connected within a Causal Loop Diagram and what feedback mechanisms emerge. However, as Legros and Cislaghi (2020) demonstrate, these differences should not be understood as fixed disciplinary boundaries. Many of the most persistent disagreements surrounding social norms cut across disciplines and instead reflect broader theoretical debates about whether norms are primarily individual perceptions or collective social structures, and whether their influence on behaviour is direct or mediated. The purpose of Table 1 is therefore not to identify a single correct definition of a pro-climate social norm, but to illustrate why the development of a shared systems representation requires explicit discussion and negotiation of variable definitions and underlying assumptions.

At the same time, the example highlights the value of systems mapping as a knowledge integration approach. Despite their conceptual differences, most perspectives agree that norms are socially produced, influence decision-making, and affect collective outcomes. Visual systems mapping can therefore provide a structured environment in which alternative interpretations become explicit, can be critically discussed, and ultimately integrated into a shared representation of the system.

Table 1: Illustrative disciplinary perspectives on the variable "pro-climate social norm" and their implications for CLD development

Discipline	**Interpretation of "Pro-Climate Social Norm"**	**Typical underlying assumption**	**Implication for CLD development**
Social/Environmental Psychology	A norm reflects individuals' perceptions of what relevant others do (descriptive norms) and what they approve of (injunctive norms) (Keizer & Schultz, 2018). Climate-related behaviour is influenced by perceived expectations of reference groups (group identity).	Norms operate primarily through individual cognition, perception, and social influence.	The variable is likely located close to individual attitudes, perceptions, self-efficacy, and behaviour. Polarisation may alter which reference groups become relevant.
Sociology	Norms are collective expectations and shared standards embedded within social groups, communities, and broader social structures. Competing groups may maintain different climate-related norms simultaneously (Barkan, 2017).	Norms are properties of social systems rather than individuals.	The variable is primarily situated at the societal level and linked to identities, group membership, social cohesion, and societal polarisation.
Political Science	Norms are institutionalised expectations, practices, and rules that structure political and social behaviour (Katzenstein, 1996). Climate norms may become embedded in governance arrangements, legislation, and public institutions.	Norms are reinforced through formal organisations, institutions, and political power structures.	The variable may connect societal expectations with political institutions, policy acceptance, legitimacy, and trust in governance.
Behavioural Economics	Norms are internalised behavioural dispositions that shape decisions beyond narrow self-interest, including fairness concerns, reciprocity, and social preferences (Bowles & Chen, 2025).	Norms influence decision-making alongside incentives and material interests.	The variable is closely connected to behavioural choices, perceived costs and benefits, distributional fairness, and economic decision processes.

3.2. Preliminary CLD system structure

Figure 1 presents the first draft of the Causal Loop Diagram (CLD) developed in this study. As discussed in the Methods section, the diagram should not be interpreted as a validated representation of the real-world system. Rather, it represents a preliminary synthesis of insights from different disciplinary perspectives and serves as a starting point for further interdisciplinary discussion, critique, and refinement.

The current version of the CLD suggests that populist climate obstruction may emerge from the interaction of anti-climate attitudes, anti-climate social norms, low societal acceptance of climate policies, and political dynamics that oppose or undermine climate action. Rather than identifying single causes, the CLD highlights how these factors may become interconnected through feedback structures operating across multiple domains.

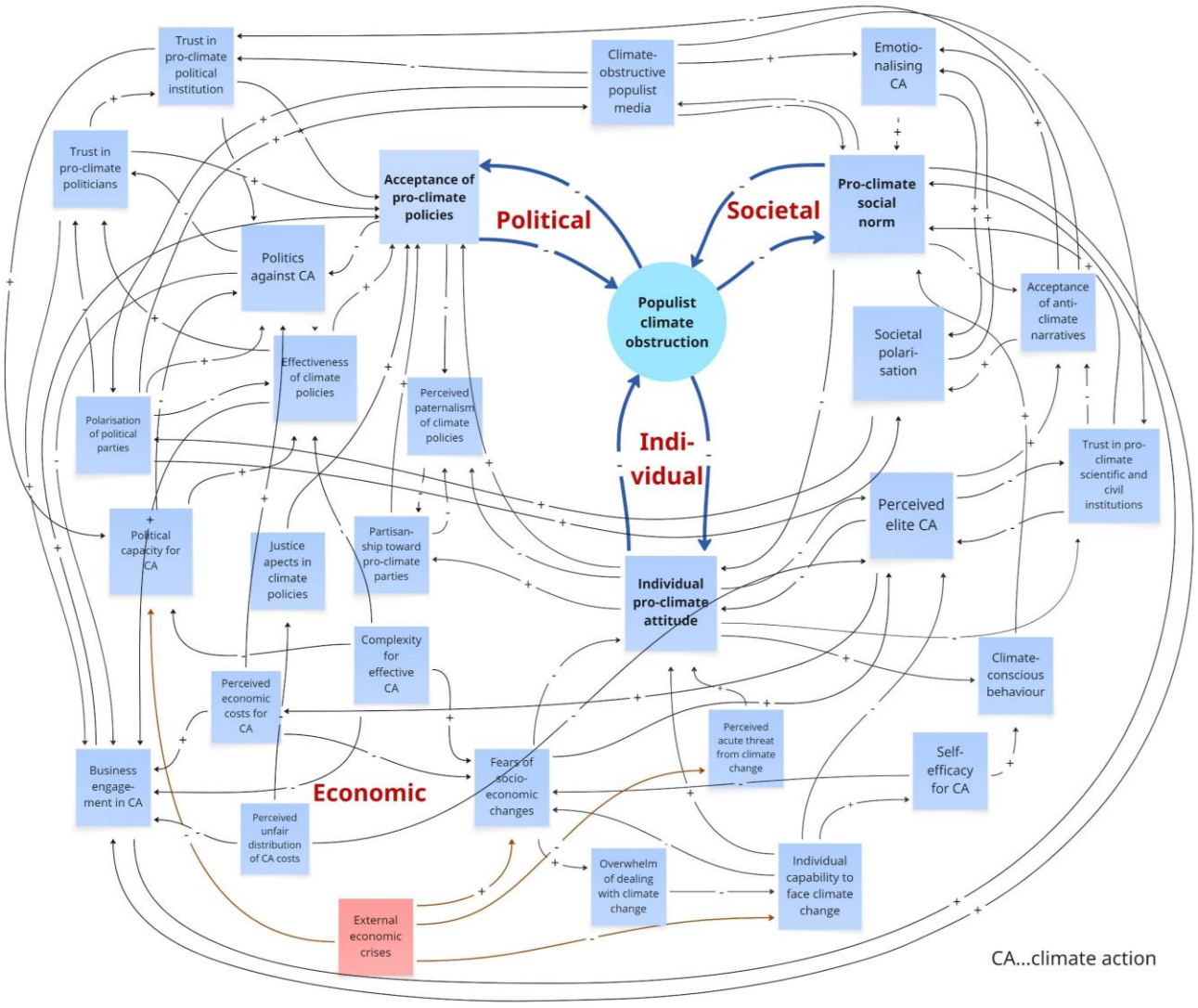

Figure 1: A Causal Loop Diagram draft explaining the correlation between political, economic, media, individual and societal dimensions for populist climate obstruction

The model is organised around four interacting system domains: individual, societal, political, and economic (see Table 2). These domains do not represent isolated stakeholder groups but rather clusters of processes and mechanisms that are analytically distinct while remaining dynamically interconnected. Many variables could plausibly be assigned to multiple domains, reflecting the interdisciplinary nature of the phenomenon and the different theoretical perspectives discussed in the previous section. The domains therefore serve primarily as a heuristic structure intended to improve readability and facilitate interdisciplinary dialogue.

The preliminary CLD contains substantially more reinforcing than balancing feedback loops. This observation does not constitute empirical evidence about the real-world system but reflects the current structure of the model and the assumptions embedded in the literature reviewed and the authors' interpretations. The predominance of reinforcing loops suggests a working hypothesis that processes related to trust, social norms, political alignment, and climate attitudes may become self-reinforcing over time, whereas balancing mechanisms may be weaker, delayed, or less visible within existing research. Future iterations of the CLD may challenge, refine, or overturn this interpretation.

External shocks and crises were included as exogenous influences on the system. Examples include economic crises, pandemics, geopolitical conflicts, and climate-related extreme events. Depending on context and framing, such events may strengthen or weaken populist climate obstruction. Economic or geopolitical crises may increase perceptions of socio-economic insecurity and redirect political attention away from climate action, while severe climate impacts may increase perceived urgency and support for climate policies. The precise role of such external disturbances remains an important topic for future model development and validation.

Table 2: Domains and illustrative processes in the CLD

Domain	**Illustrative processes**
Individual	perceptions, emotions, motivations, attitudes, behaviour
Societal	social norms, polarisation, collective identities, public discourse
Political	institutions, governance, parties, policies, political trust
Economic	markets, distributional effects, firms, economic insecurity, investment dynamics

3.3. Selected feedback structures

The preliminary CLD contains numerous reinforcing and balancing feedback loops. Given the exploratory nature of the model, the purpose of this section is not to provide an exhaustive description of all identified loops. Instead, three feedback structures are highlighted because they are strongly represented in the literature reviewed and illustrate how populist climate obstruction may emerge from interactions across individual, societal, political, and economic domains. In addition, they connect multiple system domains, thereby illustrating the integrative value of the CLD

Perceived-elite polarisation loop

(Perceived elite climate action (+) → Acceptance of anti-climate narratives (+) → Societal polarisation (+) → Emotionalising of climate action (−) → Pro-climate social norm (−) → Populist climate obstruction (−) → Individual pro-climate attitude (−) → Perceived elite climate action)

In this reinforcing loop, increasing perceived elite climate action makes anti-climate narratives more appealing and acceptable, particularly when climate policies are perceived as being driven by political, scientific, or cultural elites. Greater acceptance of anti-climate narratives contributes to higher levels of societal polarisation, which intensifies the emotionalising of climate action. As climate debates become increasingly shaped by identity-based and emotional conflict, pro-climate social norms weaken, creating favourable conditions for stronger populist climate obstruction. Increased obstruction subsequently reduces individual pro-climate attitudes, which can further strengthen perceptions that climate action is detached from the concerns of ordinary citizens and primarily reflects elite interests. As a result, perceived elite climate action increases, reinforcing the feedback loop. This mechanism illustrates how elite-centred interpretations of climate policy can increase the resonance of anti-climate narratives, deepen societal divisions, and sustain opposition to climate action over time.

Norm Erosion Loop

(Populist climate obstruction (−) → Pro-climate social norm (-) → Acceptance of anti-climate narratives (+) → Societal polarisation (+) → Polarisation of political parties (+) → Politics against climate action (−) → Acceptance of pro-climate policies (−) → Populist climate obstruction)

In this reinforcing loop, increasing populist climate obstruction weakens pro-climate social norms by challenging the social legitimacy of climate action. As these norms erode, the acceptance of anti-climate narratives increases, making climate-related issues more contested and contributing to greater societal polarisation. Rising societal polarisation further intensifies the polarisation of political parties, strengthening politics against climate action and reducing the acceptance of pro-climate policies. Lower policy acceptance creates favourable conditions for stronger populist climate obstruction, thereby reinforcing the loop. This mechanism illustrates how the erosion of shared climate-related norms can increase the resonance of anti-climate narratives, deepen political divisions, and sustain resistance to climate action over time.

Media Amplification Loop

(Climate-obstructive populist media (+) → Polarisation of political parties (-) → Trust in pro-climate politicians (+) → Acceptance of pro-climate policies (-) → Populist climate obstruction (−) → Pro-climate social norm (−) → Climate-obstructive populist media)

In this reinforcing loop, climate-obstructive populist media contributes to greater polarisation of political parties, which reduces trust in pro-climate politicians. Lower trust weakens the acceptance of pro-climate policies, creating opportunities for stronger populist climate obstruction. As obstruction increases, pro-climate social norms weaken, making climate-obstructive narratives more resonant and increasing the influence of climate-obstructive populist media. The loop therefore amplifies political conflict and reinforces societal resistance to climate action through media-driven polarisation and declining trust.

Taken together, these three feedback structures suggest that populist climate obstruction may be sustained through interacting processes of polarisation, trust erosion, and the weakening of pro-climate social norms. While the existence and relative importance of these feedbacks require further empirical assessment and interdisciplinary validation, they provide an initial illustration of how systems thinking can help integrate insights from multiple disciplinary perspectives into a shared explanatory framework. One value of this kind of knowledge integration becomes visible precisely at the point of disciplinary comparison: across all three loops, the disciplines discussed above would agree on the direction of the dynamic (pro-climate social norm weakening) but would disagree on what is actually weakening and which mechanism is driving it. For example, in the Perceived-Elite Polarisation Loop, the disciplines would broadly agree on the overall dynamic but diverge on which step is most consequential and therefore most sensitive to change. Social psychology might place the emphasis on the emotionalising of climate action: the norm loses its anchoring when climate becomes affectively coded as an elite identity marker, shifting what individuals perceive their reference group to approve of. Behavioural economics might locate the critical weight in the same step but for a different reason: the norm weakens because rising polarisation makes the distribution of climate-policy costs appear increasingly unfair, undermining the behavioural standard. Sociology might look earlier in the chain, at the step from narrative acceptance to societal polarisation: the norm does not erode primarily through individual perceptions but through the structural fracturing of a shared societal standard. Political science might place the emphasis on perceived elite climate action as the step where the norm is actively delegitimised as a technocratic imposition rather than a democratically grounded standard.

3.4. Deep renovation as a promising case for future stakeholder-based model development

The preliminary CLD developed in this study addresses populist climate obstruction as a general phenomenon. While this broad perspective is useful for integrating mechanisms identified across different disciplines, it also creates a challenge: the concept encompasses diverse climate policies, political contexts, and forms of obstruction. A concrete transformation case is therefore important for moving from an abstract systems

representation towards the examination of how these mechanisms operate in a specific policy and societal context. A case can make the proposed feedback structures more tangible, reveal context-specific mechanisms and stakeholder perspectives, and provide a concrete setting in which the preliminary CLD can be challenged and further developed through Group Model Building.

Deep renovation of Germany's residential building stock provides a particularly promising case for this next step. Deep renovation refers to the comprehensive transformation of existing building stock towards climate-neutral and climate-resilient performance, combining energy-efficiency improvements, renewable energy use, and climate adaptation measures (BPIE, 2021). Renovation dynamics are problematic because they remain below the levels required to meet climate targets, indicating persistent implementation gaps (BuVEG, 2025). At the same time, residential renovation involves highly heterogeneous ownership structures, financial capacities, housing situations, and decision-making contexts, which can lead to uneven behavioural responses and policy impacts across social groups (Gram-Hanssen, 2014; Schünemann, 2025). Finally, recent policy processes demonstrate the political and societal contestation surrounding transformative interventions in the building sector. The 2023 reform process surrounding the German Building Energy Act was accompanied by polarising narratives such as the "heating hammer" and claims of "expropriation through the back door", contributing to substantial policy dilution (Galvin, 2023; Haas et al., 2025). Together, these characteristics make deep renovation a particularly suitable empirical setting for examining how material concerns, perceptions of fairness, trust, political polarisation, and anti-elite narratives may interact with climate-policy implementation.

The case also illustrates why stakeholder-oriented knowledge integration should not be understood simply as an extension of interdisciplinary integration. Different stakeholders may attach different meanings, concerns, causal assumptions, and action logics to the same transformation process. A participatory systems-mapping process can make these mental models explicit and examine how they relate to the systemic hypotheses represented in the general CLD. This addresses a different knowledge-integration challenge from interdisciplinary synthesis: while the latter integrates theories, concepts, empirical findings, and causal assumptions across scientific disciplines, stakeholder-oriented integration brings experiential, practical, institutional, and political knowledge into dialogue with the scientific representation.

Table 3 illustrates why such a process may generate insights that cannot be obtained by adding further scientific disciplines alone. The stakeholder perspectives presented are illustrative rather than an empirical classification of actual stakeholder positions. They indicate how the same transformation may involve different perceived costs, fairness judgements, institutional constraints, and causal expectations. Future stakeholder-based model development could therefore use deep renovation as a concrete setting in which to examine whether the feedback structures identified in the general CLD are interpreted similarly across actor groups, or whether they need to be challenged, extended, or substantially revised.

Table 3: Illustrative stakeholder perspectives on deep renovation and their potential implications for systems mapping

Stakeholder perspective	How deep renovation may be perceived	Potential concern or mechanism
Policy-makers	Necessary transformation to achieve climate and energy targets	Policy legitimacy; implementation capacity
Property owners	Financial burden and intervention in private decision-making	Perceived costs; fairness; autonomy
Tenants	Potential benefits for energy costs and housing quality, but also risks of rent increases	Distributional effects; housing affordability
Building industry & crafts sector	Major transformation and investment opportunity, but also a regulatory and capacity challenge	Costs; skills; investment uncertainty
Climate movements & NGOs	Necessary transformation, potentially with insufficient ambition or implementation	Ambition; implementation gap

Populist political actors	Elite-driven intervention imposed on ordinary citizens	Anti-elite narratives; polarisation
Scientific / expert actors	Evidence-based instrument for reducing emissions and improving building performance	Effectiveness; policy design

4. Discussion

4.1 Preliminary consistency with existing literature

The CLD presented in this study should be understood as a preliminary systems representation rather than an empirically validated model. Nevertheless, both its overall structure and several of its proposed feedback mechanisms are broadly consistent with findings from existing research on climate politics, populism, public attitudes, and climate communication.

The overall system structure is broadly consistent with literature from multiple disciplines, each of which highlights different but interconnected dimensions of populist climate obstruction. Political science has highlighted the role of populist anti-elitism, political polarisation, and party competition in shaping climate policy resistance (Dernbach, 2025; Lockwood, 2018). Sociological research has emphasised the importance of social norms, collective identities, and societal divisions in shaping climate-related attitudes and behaviour (Legros & Cislaghi, 2020; Tajfel, 1974). Social and environmental psychology have examined the influence of perceptions, trust, emotions, and attitudes towards climate action (Georgi et al., 2022; Rayner, 2010; Rees & Bamberg, 2014), while economics has focused on distributional concerns, perceived costs, and material interests associated with climate policies (Bosetti et al., 2025). The four-domain structure of the CLD therefore reflects an attempt to integrate these complementary perspectives into a shared analytical framework and highlights that populist climate obstruction emerges through interactions between individual, societal, political, and economic processes rather than from any single cause.

Several of the selected feedback loops are also supported by empirical findings. The *Perceived-Elite Polarisation Loop* is consistent with research showing that climate policies can become politically contested when they are framed as projects imposed by political, scientific, or cultural elites (Marquardt & Lederer, 2022). Right wing populist narratives frequently construct climate action as an elite-driven agenda that neglects the interests and concerns of ordinary citizens through two structural pathways: the material grievances of those bearing the costs of climate policy and an ideological hostility to climate governance an inherently technocratic and cosmopolitan project (Lockwood, 2018). Both pathways contribute to the acceptance of anti-climate narratives and the deepening of societal polarisation, a dynamic Bosetti et al. (2025) document empirically through evidence that green backlash intensifies as climate policies are perceived as imposing disproportionate costs, and Gettins and Meister (2025), for example, demonstrate that narratives emphasising unequal burdens and perceived unfairness of climate policies can increase scepticism towards climate action, supporting the central dynamics represented in this loop. Meijers et al. (2023) show that the relationship between populist attitudes and climate policy opposition is mediated through anti-elite dispositions, supporting the proposed links between perceived elite climate action, anti-climate narratives, and declining support for climate policy.

The *Norm Erosion Loop* is broadly aligned with research highlighting the importance of social norms and policy legitimacy for climate governance. Studies indicate that public support for climate policies depends strongly on perceptions of fairness, effectiveness, and social acceptance (Dechezleprêtre et al., 2025). Climate obstruction has been characterised as an organised and self-reinforcing phenomenon that systematically challenges the social legitimacy of climate action (Roberts et al., 2025), weakening pro-climate social norms as shared behavioural standards whose effectiveness depends on perceived social consensus (Allcott, 2011). As these norms erode, pro-climate norm messages not only lose effectiveness but can produce backfire effects among politically sorted subgroups (Costa & Kahn, 2013). The resulting increase in anti-climate narrative acceptance sustains societal polarisation, driven in part by organised counter-movement actors who have systematically produced climate doubt and built durable institutional infrastructure for obstruction

(Dunlap & McCright, 2015; Brulle, 2014). When climate action loses legitimacy within important social groups, resistance may spread beyond individual attitudes and become embedded in broader political conflicts. The feedback structure proposed in the CLD suggests that populist climate obstruction may contribute to the erosion of pro-climate social norms, thereby reinforcing political polarisation and reducing policy acceptance.

The *Media Amplification Loop* is consistent with a growing literature on media ecosystems, political trust, and climate communication. Research has shown that climate-sceptical and populist media narratives can increase political polarisation, undermine trust in political and scientific actors, and influence public perceptions of climate policies (Forchtner, 2019), with long-run evidence showing that a substantial portion of partisan polarisation of climate policy-relevant attitudes is explained by changes in the attitudes of right populist party supporters (Caldwell et al., 2025). As party polarisation deepens, trust in pro-climate politicians collapses: (Fairbrother, 2017) demonstrates that political distrust is the central mediating variable between environmental concern and policy opposition, with Rayner (2010) showing that trust operates as a structural precondition for policy acceptance rather than a marginal influence on it. The reverse dynamic (pro-climate norms emerging and spreading through media independently of institutional channels) is illustrated by the "flygskam" (flight shame) movement, in which a norm of not flying spread through social media and generated measurable shifts in both behaviour and policy attitudes (Becken et al., 2021). The CLD extends these findings by hypothesising a reinforcing process through which weakened social norms increase the resonance of climate-obstructive narratives, thereby further strengthening their influence.

Taken together, the literature provides preliminary support for both the multidimensional system structure and the selected feedback mechanisms represented in the CLD. However, the existence, strength, and relative importance of the proposed causal relationships remain hypotheses that require further empirical assessment. Future interdisciplinary research could use the CLD as a framework for systematically testing these relationships and identifying which mechanisms are most influential in sustaining populist climate obstruction.

4.2 Potential leverage points

One advantage of systems mapping is its ability to identify potential areas where interventions may influence broader system dynamics (Abson et al., 2017; Meadows & Wright, 2011). Given the exploratory and non-validated nature of the present CLD, the following examples should be understood as hypotheses emerging from the preliminary system representation rather than as validated leverage points or policy recommendations.

- **Reframing climate action as fair and inclusive.** Several feedback structures suggest that perceptions of elite-driven and unfair climate action contribute to the acceptance of anti-climate narratives and societal polarisation. Policy design and communication that emphasise fairness, participation, and shared societal benefits may therefore influence multiple reinforcing feedbacks simultaneously.
- **Strengthening pro-climate social norms.** The CLD identifies pro-climate social norms as a central connecting variable linking individual attitudes, political acceptance, media dynamics, and populist climate obstruction. Strengthening the social legitimacy of climate action may therefore reduce the susceptibility of societies to reinforcing obstruction dynamics.
- **Reducing societal and political polarisation.** Across all three illustrative feedback loops, societal and political polarisation emerge as central reinforcing mechanisms. Interventions that reduce identity-based conflict and encourage dialogue across social and political groups may weaken several reinforcing feedback structures at the same time.
- **Strengthening trust and policy legitimacy.** The model suggests that trust in pro-climate actors and the perceived legitimacy of climate policies play an important role in shaping policy acceptance. Increasing

transparency, public participation, and responsiveness in climate-policy processes may therefore improve acceptance while reducing perceptions that climate action primarily serves elite interests.

Importantly, these potential leverage points are derived from the general CLD and should not be interpreted as case-specific recommendations. A particularly promising next step would be to examine whether and how these mechanisms operate in a concrete transformation context such as deep renovation of the German residential building stock.

4.3 Limitations and future model development

Several limitations of the present study should be acknowledged. First, the CLD represents a preliminary synthesis developed by the authors and has not yet undergone systematic validation by disciplinary experts or stakeholders. Consequently, the variables, causal relationships, and feedback structures represented in the diagram should be interpreted as hypotheses rather than established findings.

Second, the present study primarily demonstrates interdisciplinary knowledge integration among scientific disciplines. Stakeholder-oriented or transdisciplinary knowledge integration represents a complementary but analytically distinct form of knowledge integration that has not yet been empirically conducted in this study. Future development should therefore distinguish between continued interdisciplinary refinement of the general CLD and its subsequent validation and extension through stakeholder engagement.

Third, the current model intentionally prioritises accessibility and explainability over completeness. Many potentially relevant variables, feedback loops, and cross-domain interactions have been simplified or omitted. Similarly, important delays between causes and effects are not yet explicitly represented, although such delays are often critical for understanding political, societal, and behavioural dynamics. Furthermore, the four-domain structure of the CLD should be understood as a heuristic simplification rather than a definitive representation of system boundaries. Alternative classifications, domain definitions, or system boundaries may reveal additional interactions, variables, and feedback mechanisms that are not captured in the current version of the model.

Fourth, the disciplinary perspectives incorporated into the model remain limited. Future development should involve researchers from political science, sociology, psychology, economics, communication studies, and systems science to critically examine variable definitions, causal assumptions, and system boundaries. In parallel, stakeholder-oriented validation will be required to examine how the proposed systemic relationships are understood by actors involved in or affected by climate transformation.

Future model development should therefore proceed iteratively, moving from the present literature- and discipline-based representation towards interdisciplinary expert review and subsequent stakeholder-oriented Group Model Building. A concrete empirical case such as deep renovation can provide the context in which this further validation and extension takes place, without implying that the present CLD is already case-specific.

4.4 Outlook

This first CLD should primarily be understood as a boundary object designed to facilitate interdisciplinary dialogue on populist climate obstruction. The paper points to two complementary directions for future knowledge integration: continued interdisciplinary refinement among scientific disciplines and transdisciplinary stakeholder-oriented integration with actors involved in or affected by climate transformation.

Future research should focus on four priorities:

- Interdisciplinary review and validation of variables, causal relationships, and feedback structures
- Participatory Group Model Building workshops involving researchers and relevant stakeholders to develop Causal Loop Diagram as a qualitative system presentations
- Integration of additional feedback mechanisms, delays, and competing mental models, including those emerging from stakeholder perspectives

- Exploration of whether the resulting qualitative model can serve as a foundation for future quantitative System Dynamics modelling

These steps would allow the general CLD to be progressively tested, refined, and contextualised in concrete climate-transformation settings. Deep renovation represents one particularly promising setting for such future work, but the approach could also be transferred to other contested climate-policy domains. Through these iterative processes, the CLD may evolve into a more robust systems representation capable of supporting both interdisciplinary and stakeholder-oriented knowledge integration and the identification of potential responses to populist climate obstruction.

Conclusion

This article introduced populist climate obstruction as an interdisciplinary umbrella concept and presented a first draft of a CLD as a systems-based representation of the phenomenon. The exercise demonstrated the potential of systems mapping to integrate insights from different disciplinary traditions and to make assumptions, variables, and feedback structures explicit. In doing so, the CLD serves less as a validated explanation of populist climate obstruction than as a boundary object designed to support inter- and transdisciplinary dialogue and knowledge integration.

The preliminary model suggests that populist climate obstruction may emerge from interacting dynamics across individual, societal, political, and economic domains, particularly through feedback structures related to polarisation, trust, social norms, and socio-economic insecurity. However, these relationships should be understood as working hypotheses rather than empirically validated findings.

The primary contribution of this study is therefore methodological as much as substantive. By demonstrating how Systems Thinking and visual systems mapping can be applied to study populist climate obstruction, the paper provides a starting point for future inter- and transdisciplinary collaboration. At the same time, the study highlights that interdisciplinary integration among scientific disciplines and stakeholder-oriented knowledge integration constitute complementary but distinct next steps. While the present CLD provides an initial systems representation based on literature and disciplinary expertise, future participatory research can examine how different actors involved in or affected by climate transformation interpret and potentially revise these proposed dynamics.

Deep renovation of the German residential building stock provides a particularly promising context for such future research because it combines complex decision-making, heterogeneous distributional effects, and political contestation. Stakeholder-oriented Group Model Building in this context could test, challenge, and extend the general CLD, contributing to a more context-sensitive systemic understanding of how populist climate obstruction may interact with concrete climate transformation processes. The present CLD is therefore not a case-specific model of climate obstruction in deep renovation, but a starting point from which such an empirical and participatory investigation can be developed.

Funding

This research was funded by

- Germany’s Federal Ministry of Research, Technology and Space [Research group REXKLIMA, 01UG2240B]",
- Leibniz Institute of Ecological and Regional Development (IOER) [IOER project ‘DEKASYS: Decarbonisation of the German Residential Building Stock—Qualitative and Quantitative System Modelling of the Societal Motivation Processes to Increase the Energetic Renovation Dynamics and the Effectiveness of Policy Instruments’],
- by the European Commission's Data Collection Framework (DCF).

AI Use Declaration

During manuscript preparation, the authors used OpenAI's ChatGPT (GPT-5.5) to support language editing, text revision, and structural refinement of selected sections. The authors reviewed and edited all generated content and take full responsibility for the final manuscript. No AI tool was used to generate research results, analyse data, or make scientific conclusions.

References

Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., Von Wehrden, H., Abernethy, P., Ives, C. D., Jager, N. W., & Lang, D. J. (2017). Leverage points for sustainability transformation. *Ambio*, *46*(1), 30–39. https://doi.org/10.1007/s13280-016-0800-y

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics*, *95*(9–10), 1082–1095. https://doi.org/10.1016/j.jpubeco.2011.03.003

Barkan, S. E. (2017). *Sociolgy: Understanding and changing the social world, comprehensive edition* (Comprehensive edition. Version 2.0). Flatworld.

Becken, S., Friedl, H., Stantic, B., Connolly, R. M., & Chen, J. (2021). Climate crisis and flying: Social media analysis traces the rise of "flightshame". *Journal of Sustainable Tourism*, *29*(9), 1450–1469. https://doi.org/10.1080/09669582.2020.1851699

Best, A., & Holmes, B. (2010). Systems thinking, knowledge and action: Towards better models and methods. *Evidence & Policy*, *6*(2), 145–159. https://doi.org/10.1332/174426410X502284

Black, L. J. (2013). When visuals are boundary objects in system dynamics work. *System Dynamics Review*, *29*(2), 70–86. https://doi.org/10.1002/sdr.1496

Boardman, J., & Sauser, B. (2013). *Systemic thinking: Building maps for worlds of systems*. Wiley.

Bosetti, V., Colantone, I., De Vries, C. E., & Musto, G. (2025). Green backlash and right-wing populism. *Nature Climate Change*, *15*(8), 822–828. https://doi.org/10.1038/s41558-025-02384-0

Bowles, S., & Chen, W. (2025). *Allocation, distribution, and policy: Notes, problems, and solutions in microeconomics*. Open Book Publishers.

BPIE. (2021). *Deep Renovation: Shifting from exception to standard practice in EU Policy.* Buildings Performance Institute Europe. ttps://www.bpie.eu/ publication/deep-renovation-shifting-from-exception-to-standard-practice-in-eu-policy/

Brulle, R. J. (2014). Institutionalizing delay: Foundation funding and the creation of U.S. climate change counter-movement organizations. *Climatic Change*, *122*(4), 681–694. https://doi.org/10.1007/s10584-013-1018-7

BuVEG. (2025). *Sanierungsquote*. Bundesverband energieeffiziente Gebäudehülle e.V. https://buveg.de/sanierungsquote/

Caldwell, D., Cohen, G., & Vivyan, N. (2025). Long-run trends in partisan polarization of climate policy-relevant attitudes across countries. *Environmental Politics*, *34*(5), 767–792. https://doi.org/10.1080/09644016.2024.2403957

Costa, D. L., & Kahn, M. E. (2013). Energy conservation „nudges" and environmentalist ideology: Evidence from a randomized residential electricity field experiment. *Journal of the European Economic Association*, *11*(3), 680–702. https://doi.org/10.1111/jeea.12011

Dechezleprêtre, A., Fabre, A., Kruse, T., Planterose, B., Sanchez Chico, A., & Stantcheva, S. (2025). Fighting Climate Change: International Attitudes toward Climate Policies. *American Economic Review*, *115*(4), 1258–1300. https://doi.org/10.1257/aer.20230501

Dernbach, B. (2025). Nachhaltiger Gesellschaftswandel war gestern. Was Medien mit der Abkehr von der „grünen" Vision zu tun haben. *Communicatio Socialis*, *58*(1), 53–62. https://doi.org/10.5771/0010-3497-2025-1-53

Dunlap, R. E., & McCright, A. M. (2015). Challenging climate change: The denial countermovement. In *Climate change and society: Sociological perspectives* (S. 300–332). Oxford University Press.

Ekberg, K., Forchtner, B., & Hultman, M. (2023). *Climate obstruction: How denial, delay and inaction are heating the planet* (First Edition). Routledge.

Fairbrother, M. (2017). Environmental attitudes and the politics of distrust. *Sociology Compass*, *11*(5), e12482. https://doi.org/10.1111/soc4.12482

Forchtner, B. (2019). Climate change and the far right. *WIREs Climate Change*, *10*(5), e604. https://doi.org/10.1002/wcc.604

Galvin, R. (2023). An under-developed dimension in upgrading energy-inefficient German rental buildings: Corporate social responsibility as a hybrid form of governance. *Energy Research & Social Science*, *101*, 103148. https://doi.org/10.1016/j.erss.2023.103148

Georgi, A., Jacob, R., & Dshemuchadse, M. (2022). 3.5 Systemische Perspektiven auf Klimagefühle. In K. Van Bronswijk & C. M. Hausmann (Hrsg.), *Climate Emotions* (S. 323–340). Psychosozial-Verlag. https://doi.org/10.30820/9783837978667-323

Gettins, M., & Meister, L. (2025). Narratives on the Distributional Impact of Climate Policy Can Fuel Populism. *DIW Weekly Report*, *15*, S. 245252. https://doi.org/10.18723/DIW_DWR:2025-38-1

Ghaffarzadegan, N., Lyneis, J., & Richardson, G. P. (2011). How Small System Dynamics Models can Help the Public Policy Process. *System Dynamics Review*, *27*(1), 22–44. https://doi.org/10.1002/sdr.442

Gram-Hanssen, K. (2014). Retrofitting owner-occupied housing: Remember the people. *Building Research & Information*, *42*(4), 393–397. https://doi.org/10.1080/09613218.2014.911572

Haas, T., Sander, H., Fünfgeld, A., & Mey, F. (2025). Climate obstruction at work: Right-wing populism and the German heating law. *Energy Research & Social Science*, *123*, 104034. https://doi.org/10.1016/j.erss.2025.104034

Hovmand, P. S. (2014). Group Model Building and Community-Based System Dynamics Process. In P. S. Hovmand (Hrsg.), *Community Based System Dynamics* (S. 17–30). Springer New York. https://doi.org/10.1007/978-1-4614-8763-0_2

Huber, A. (2013). *Case Study Botttop* (European Institute for Energy Research, Hrsg.).

Katzenstein, P. J. (Hrsg.). (1996). *The culture of national security: Norms and identity in world politics*. Columbia Univ. Press.

Keizer, K., & Schultz, P. W. (2018). Social Norms and Pro-Environmental Behaviour. In L. Steg & J. I. M. Groot (Hrsg.), *Environmental Psychology* (1. Aufl., S. 179–188). Wiley. https://doi.org/10.1002/9781119241072.ch18

Laclau, E. (2005). *On populist reason*. Verso.

Legros, S., & Cislaghi, B. (2020). Mapping the Social-Norms Literature: An Overview of Reviews. *Perspectives on Psychological Science*, *15*(1), 62–80. https://doi.org/10.1177/1745691619866455

Lockwood, M. (2018). Right-wing populism and the climate change agenda: Exploring the linkages. *Environmental Politics*, *27*(4), 712–732. https://doi.org/10.1080/09644016.2018.1458411

Marquardt, J., & Lederer, M. (2022). Politicizing climate change in times of populism: An introduction. *Environmental Politics*, *31*(5), 735–754. https://doi.org/10.1080/09644016.2022.2083478

Meadows, D. H., & Wright, D. (2011). *Thinking in systems: A primer* (Nachdr.). Chelsea Green Pub.

Meijers, M. J., Van Drunen, Y., & Jacobs, K. (2023). It's a hoax! The mediating factors of populist climate policy opposition. *West European Politics*, *46*(7), 1288–1311. https://doi.org/10.1080/01402382.2022.2145447

Moffitt, B. (2016). The global rise of populism: Performance, political style, and representation. *Stanford University Press*.

Mudde, C., & Kaltwasser, R. (2017). Populism: A very short introduction. *Oxford University Press*.

Rayner, S. (2010). Trust and the transformation of energy systems. *Energy Policy*, *38*(6), 2617–2623. https://doi.org/10.1016/j.enpol.2009.05.035

Rees, J. H., & Bamberg, S. (2014). Climate protection needs societal change: Determinants of intention to participate in collective climate action. *European Journal of Social Psychology*, *44*(5), 466–473. https://doi.org/10.1002/ejsp.2032

Roberts, J. T., Milani, C. R. S., Jacquet, J., & Downie, C. (2025). Introduction: Understanding Obstruction of Climate Action. In J. T. Roberts, C. R. S. Milani, J. Jacquet, & C. Downie (Hrsg.), *Climate Obstruction* (1. Aufl., S. 1–28). Oxford University PressNew York. https://doi.org/10.1093/oso/9780197787144.003.0001

Sangervo, J., Jylhä, K. M., & Pihkala, P. (2022). Climate anxiety: Conceptual considerations, and connections with climate hope and action. *Global Environmental Change*, *76*, 102569. https://doi.org/10.1016/j.gloenvcha.2022.102569

Schünemann, C. (2025). Erhöhung der Dynamik energetischer Wohngebäudesanierung—Befragungsergebnisse zu Motivation, Hemmnissen und Lösungsansätzen für verschiedene Eigentumsverhältnisse in Deutschland. *Social Science Open Access Repository*. https://doi.org/10.26084/8056-2f80

Scott, R. (2018). *Group Model Building*. Springer Singapore. https://doi.org/10.1007/978-981-10-8959-6

Stepanova, O., Polk, M., & Saldert, H. (2020). Understanding mechanisms of conflict resolution beyond collaboration: An interdisciplinary typology of knowledge types and their integration in practice. *Sustainability Science*, *15*(1), 263–279. https://doi.org/10.1007/s11625-019-00690-z

Sterman, J. (2002). *Business Dynamics: Systems Thinking and Modeling for a Complex World*. McGraw-Hill Education.

Tajfel, H. (1974). Social identity and intergroup behaviour. *Social Science Information*, *13*(2), 65–93. https://doi.org/10.1177/053901847401300204

Veldhuis, G. A., Smits-Clijsen, E. M., Van Waas, R. P. M., Hof, T., Maccatrozzo, V., Rouwette, E. A. J. A., & Kerstholt, J. H. (2025). The influence of causal loop diagrams on systems thinking and information utilization in complex problem-solving. *Computers in Human Behavior Reports*, *17*, 100613. https://doi.org/10.1016/j.chbr.2025.100613

Vennix, J. A. M. (1996). *Group Model Building: Facilitating Team Learning Using System Dynamics*. John Wiley & Sons.

Weyland, K. (2001). Clarifying a Contested Concept: Populism in the Study of Latin American Politics. *Comparative Politics*, *34*(1), 1. https://doi.org/10.2307/422412