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Accountability Gaps in AI-Enabled Climate Decision-Support Systems

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Abstract

Artificial intelligence–enabled decision-support systems are now routinely used in climate policy, planning, and international reporting, shaping emissions estimates, mitigation pathways, adaptation priorities, and transparency assessments under the Paris Agreement. Despite this growing influence, these systems continue to be governed as technical tools rather than as institutional actors, creating accountability deficits that climate governance frameworks are not equipped to manage. This paper takes the position that AI-enabled climate decision-support systems function as de facto governance infrastructures whose outputs carry political, distributive, and accountability consequences. Treating them as neutral analytical aids obscures how algorithmic design choices encode assumptions, prioritize policy options, and reallocate epistemic authority within climate regimes. As a result, existing transparency practices, centered on disclosure of outputs and methodologies, are insufficient to sustain accountability and institutional credibility.

The paper reframes transparency in AI-enabled climate governance as an enforceable institutional condition grounded in explainability, traceability, and contestability. It identifies a structural governance gap arising from the deployment of algorithmic systems without explicit mandates, responsibility allocation, or alignment with climate reporting architectures. Left unaddressed, this gap risks undermining national reporting credibility, distorting adaptation planning, and weakening trust in collective climate processes. The analysis establishes governance, rather than innovation, as the decisive factor shaping the legitimacy of artificial intelligence in climate decision-making and delineates the minimum institutional conditions under which AI-enabled systems can be integrated without eroding the foundations of climate transparency and accountability.

Keywords: Decision-support systems; Algorithmic accountability; Climate transparency; AI governance; Policy-facing analytics; Climate reporting systems

1. Introduction

This brief employs a qualitative, non-experimental research design based on documentary and conceptual analysis. No laboratory experiments, simulations, chemical materials, or physical instruments were used. The materials analyzed consist of publicly available sources relevant to the governance of artificial intelligence in climate decision-making, including international climate governance frameworks, policy briefs, peer-reviewed academic literature, institutional publications, and selected news articles. These materials were examined to assess how AI-enabled decision-support systems are integrated into climate policy, reporting, and planning processes. The analysis was conducted through structured qualitative review and synthesis, focusing on institutional roles, accountability arrangements, transparency mechanisms, and governance implications of AI-enabled climate decision-support systems. All figures included in the manuscript are reproduced from publicly accessible sources for illustrative purposes, with full source attribution provided. No proprietary or restricted-access data were used. This brief did not involve human participants, human

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data, animal studies, or experimental interventions. Accordingly, ethical approval and informed consent were not required.

Figure 1 Screenshot of UNESCO communication on artificial intelligence and climate action.
Source: UNESCO official website or communication materials

2. Discussion

Artificial intelligence–enabled decision-support systems are increasingly positioned at the core of contemporary climate governance. Across mitigation planning, adaptation prioritization, climate finance allocation, and transparency and reporting processes, algorithmic tools are now used to aggregate datasets, generate scenarios, rank policy options, and synthesize complex information into policy-facing analytics. These systems are frequently framed as neutral enablers of efficiency and innovation, capable of improving evidence-based decision-making in a context of escalating climate urgency. Yet this framing obscures a more fundamental transformation: artificial intelligence is no longer merely assisting climate analysis; it is actively reshaping how climate knowledge is produced, validated, and mobilized within institutional settings.

This shift is particularly consequential in the domain of climate transparency and reporting infrastructures. Nationally Determined Contributions, Biennial Transparency Reports, global stock take inputs, and adaptation communications increasingly rely on analytical platforms that incorporate machine learning, automated data harmonization, and predictive modeling. As a result, artificial intelligence–enabled climate decision-support systems are becoming embedded within formal governance processes that demand high standards of credibility, accountability, and political legitimacy. Despite this, the governance of such systems has received limited systematic scrutiny. Much of the existing literature treats artificial intelligence in climate contexts as a technical optimization problem or an ethical concern detached from institutional practice, rather than as an emergent layer of governance with material effects on policy outcomes.

The problem addressed in this position paper lies in this governance gap. While climate decision-support systems increasingly influence how emissions trajectories are assessed, how adaptation priorities are ranked, and how progress is communicated internationally, they often operate without clear institutional mandates, transparent accountability structures, or alignment with established reporting norms. Decisions about data selection, model architecture, weighting of indicators, and treatment of uncertainty are frequently embedded within proprietary or opaque systems, leaving policymakers and reporting entities reliant on outputs they may not fully understand, contest, or audit. In this sense, artificial intelligence risks reintroducing opacity into climate governance at precisely the moment when transparency has become a cornerstone of international climate cooperation.

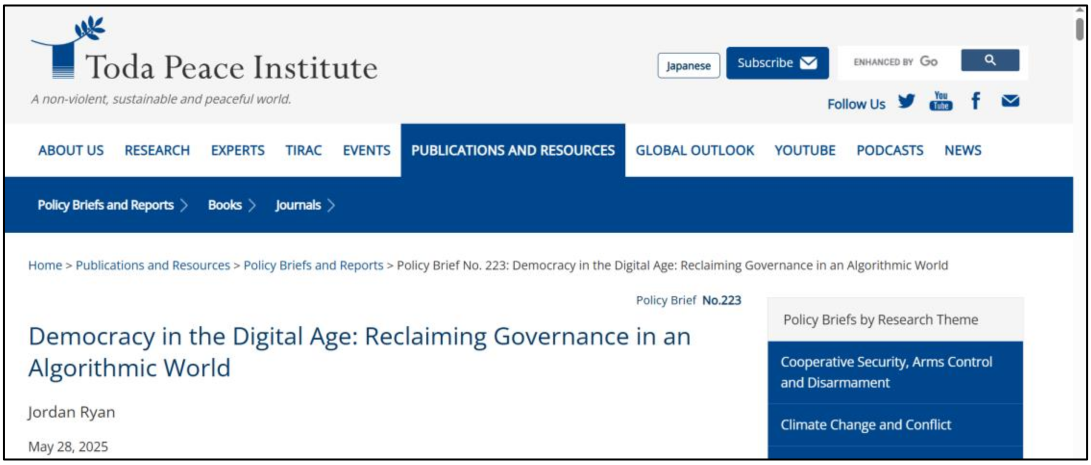


Figure 2 Screenshot of the policy brief Democracy in the Digital Age: Reclaiming Governance in an Algorithmic World. Source: Toda Peace Institute, Policy Brief No. 223 (Ryan, 2025)

This problem is not merely technical; it is fundamentally institutional and political. Climate governance relies on trust between states, between national and international bodies, and between scientific expertise and policy authority. When algorithmic systems shape climate narratives, policy priorities, or reporting outcomes without clearly defined responsibilities and oversight mechanisms, they challenge established accountability relationships. Responsibility becomes diffuse, shifting ambiguously between system designers, data providers, institutional users, and policymakers. In the absence of explicit governance frameworks, it becomes difficult to determine who is accountable when algorithmic outputs influence policy decisions, distort reporting incentives, or marginalize certain forms of knowledge.

Moreover, prevailing approaches to transparency in artificial intelligence are poorly suited to the needs of climate governance. Transparency is often equated with disclosure of outputs, dashboards, or high-level methodological descriptions, rather than with explainability, traceability, and contestability of decision logic. Climate reporting, by contrast, is built on principles that require not only visibility but also verifiability, consistency over time, and the capacity for technical expert review. Artificial intelligence systems that fail to meet these standards risk undermining the integrity of reporting infrastructures rather than strengthening them.

This position paper argues that artificial intelligence–enabled climate decision-support systems should be understood as governance infrastructures rather than neutral analytical tools. As such, their design, deployment, and use must be evaluated against criteria of institutional credibility, transparency, and accountability. Treating these systems as mere innovations overlooks the ways in which they structure decision-making authority, shape policy narratives, and influence compliance and trust within climate regimes. Without deliberate governance design, artificial intelligence may inadvertently entrench technocratic power, exacerbate asymmetries between actors with differing technical capacities, and weaken the legitimacy of climate reporting processes.

The purpose of this paper is therefore to reframe the discussion of AI for climate innovation through a governance and policy lens. Rather than asking what artificial intelligence can do for climate action, the paper asks under what institutional conditions artificial intelligence should be allowed to shape climate decisions.

This governance gap is unfolding against a broader public and institutional discourse that increasingly presents artificial intelligence as an indispensable accelerator of climate action. Contemporary media coverage, policy announcements, and institutional communications routinely emphasize real-time emissions tracking, AI-driven climate monitoring, automated compliance tools, and dashboard-based decision support, often accompanied by visual narratives of satellite imagery, live analytics, and instantaneous insight. These representations convey a sense of technological immediacy and control, reinforcing the perception that climate governance challenges are primarily problems of speed, scale, and data processing capacity.

3. From Climate Data to Climate Decisions: Mapping Where Artificial Intelligence Intervenes

Figure 3 Screenshot of the paper The EU's AI Power Play: Between Deregulation and Innovation.
Source: Carnegie Endowment for International Peace (Carnegie Europe), 2025

Artificial intelligence intervenes in climate governance not at a single point, but across the entire data-to-decision chain through which climate knowledge is produced, interpreted, and translated into policy action. This chain spans data generation, data harmonization, analytical modeling, indicator construction, prioritization and ranking of policy options, and the synthesis of results into reporting and decision-support outputs. Understanding where and how AI intervenes along this continuum is essential to diagnosing the governance challenges outlined in the preceding section, as each intervention point introduces specific risks related to transparency, accountability, and institutional legitimacy.

At the foundational level, artificial intelligence is increasingly deployed in climate data generation and preprocessing. Satellite-based earth observation systems now rely extensively on machine learning algorithms to detect land-use change, estimate greenhouse gas emissions, and classify climate-relevant phenomena such as deforestation, urban expansion, and wildfire activity. For example, machine learning–based remote sensing models underpin global deforestation datasets such as those produced by Global Forest Watch, which inform both national reporting and international climate finance decisions. Studies estimate that over 70 percent of contemporary satellite-derived climate indicators rely on some form of supervised or unsupervised learning for classification and anomaly detection [1]. While these systems dramatically increase data coverage and temporal resolution, they also embed algorithmic assumptions about classification thresholds, training datasets, and error tolerances that are rarely visible to downstream policy users.

The most consequential interventions, however, occur at the level of analytical modeling and scenario generation. Artificial intelligence is now widely used in integrated assessment modeling, energy system optimization, and climate impact projections. Recent surveys indicate that over 40 percent of new climate-energy models incorporate machine learning components, particularly for demand forecasting, technology diffusion modeling, and uncertainty reduction [2]. These models increasingly inform mitigation pathway assessments, net-zero scenarios, and policy feasibility analyses that directly shape national climate strategies. Yet the internal logic of such models feature selection, objective functions, and trade-off weighting, often remains opaque to policymakers, even as their outputs are treated as authoritative evidence.

Artificial intelligence also plays a growing role in the construction of indicators and composite indices used to assess climate performance and readiness. Adaptation vulnerability indices, climate finance eligibility scores, and mitigation ambition rankings frequently rely on algorithmic aggregation and weighting schemes. For instance, AI-assisted multi-criteria decision analysis is increasingly used to rank adaptation priorities across sectors and regions, influencing investment decisions by multilateral development banks and climate funds. Empirical evidence suggests that indicator weighting choices alone can shift country rankings by up to 30 percent in composite climate indices [3]. When such weighting decisions are embedded within algorithmic systems, they effectively encode normative judgments about what constitutes climate "success" or "urgency," often without explicit political deliberation.

While these tools enhance accessibility, they also act as epistemic filters, prioritizing certain signals while suppressing others. Research in policy analytics shows that automated summarization can significantly influence decision salience, with policymakers disproportionately relying on algorithmically highlighted insights under time constraints [4]. Across these intervention points, a consistent pattern emerges artificial intelligence does not merely accelerate existing analytical processes; it actively reshapes how climate knowledge is structured, prioritized, and legitimized. Decisions about data inclusion, uncertainty treatment, indicator weighting, and narrative framing are increasingly embedded within technical systems rather than exposed to institutional deliberation. This transformation is occurring in a governance context that demands transparency, comparability, and accountability, yet lacks clear standards for algorithmic oversight.

Figure 4 Screenshot of the Reuters news article Real-time AI tracks sustainable seafood as High Seas Treaty kicks in. Source: Reuters (Hillson, 2026)

Empirical data underscores the scale of this transformation. According to the World Economic Forum, over 60 percent of climate-related policy tools deployed by international organizations now incorporate machine learning components, a figure expected to exceed 80 percent by 2030. At the same time, fewer than 25 percent of these tools are governed by formal transparency or auditability protocols aligned with public-sector accountability standards [5]. This discrepancy highlights the core challenge identified in this paper: artificial intelligence is rapidly becoming integral to climate decision-making, while governance frameworks lag its institutionalization.

The implications of this gap are profound. When AI-enabled systems shape emissions estimates, adaptation priorities, or reporting narratives, they influence compliance assessments, resource allocation, and international trust. Yet responsibility for these outcomes is often diffuse, obscured by technical complexity and institutional fragmentation. Policymakers may rely on algorithmic outputs without the capacity to interrogate their assumptions, while developers operate outside formal accountability structures. This disconnect undermines the principles of transparency and verifiability that underpin climate governance.

In mapping these intervention points, this section demonstrates that artificial intelligence operates not at the margins, but at the core of climate decision-making processes. The challenge, therefore, is not whether AI should be used in climate governance, but how its use can be institutionally governed in ways that preserve credibility, accountability, and democratic legitimacy. Addressing this challenge requires moving beyond technical optimization toward explicit governance design, a task taken up in the following section on the governance gap.

4. The Governance Gap: Institutional Misalignment, Accountability Deficits, and Epistemic Risk

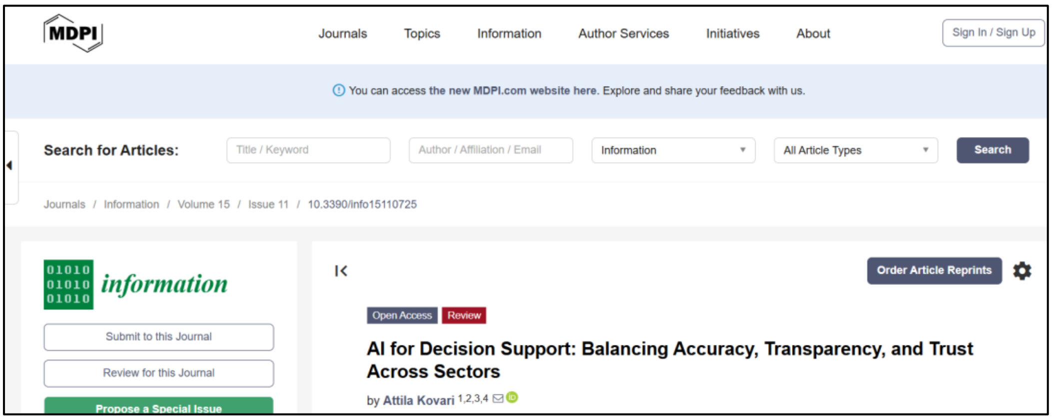
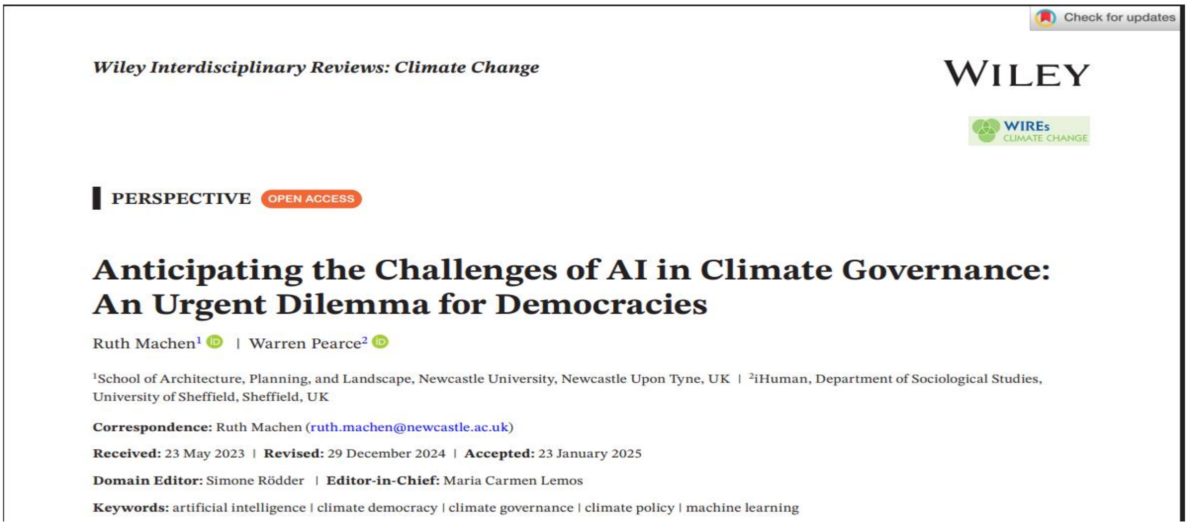


Figure 5 Screenshot of the journal article AI for Decision Support: Balancing Accuracy, Transparency, and Trust Across Sectors. Source: Information (MDPI), Kovari (2024)

Despite the rapid incorporation of artificial intelligence into climate decision-support systems, governance arrangements have not developed at a comparable pace, resulting in a structural misalignment between technical capability and institutional accountability [6]. This gap is not incidental but emerges from the convergence of innovation-driven deployment practices, fragmented institutional mandates, and the absence of sector-specific governance frameworks for algorithmic systems used in climate policy contexts [7].

A central manifestation of this governance gap is the absence of clearly defined institutional authority over artificial intelligence-enabled climate decision-support systems. Climate reporting and planning processes are generally embedded within formal mandates that specify roles, responsibilities, and review procedures, such as those governing national greenhouse gas inventories and transparency reporting [8]. In contrast, the artificial intelligence systems that increasingly support these processes are frequently developed and deployed by third-party actors, including private technology firms, academic research consortia, and international organizations, without explicit accountability arrangements linking them to reporting entities or oversight bodies [9]. As a result, decision-making authority becomes dispersed across developers, data providers, and institutional users, complicating responsibility attribution when algorithmic outputs shape policy decisions or reporting outcomes [10].



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Anticipating the Challenges of AI in Climate Governance: An Urgent Dilemma for Democracies

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Figure 6 Screenshot of the perspective article Anticipating the Challenges of AI in Climate Governance: An Urgent Dilemma for Democracies. Source: Wiley Interdisciplinary Reviews: Climate Change (Machen & Pearce, 2025)

This opacity has direct implications for governance quality. Climate reporting frameworks require explicit treatment of uncertainty, including documentation of assumptions, confidence intervals, and methodological limitations [8]. Artificial intelligence-enabled models, however, frequently internalize uncertainty within probabilistic learning processes that are not clearly communicated in policy-facing outputs [12]. As a result, decision-makers may receive apparently precise estimates or rankings without sufficient visibility into underlying uncertainty, thereby undermining informed judgment [12]. Experimental research in decision science demonstrates that policymakers tend to place disproportionate trust in algorithmic outputs presented with numerical or visual precision, even when uncertainty is substantial [13].

A further dimension of the governance gap concerns misalignment between artificial intelligence system design and established climate reporting architectures. Climate transparency frameworks are structured around principles of consistency, comparability, and expert technical review, which require traceable methodologies and standardized documentation [8]. Artificial intelligence systems, by contrast, are often optimized for predictive accuracy or computational efficiency rather than institutional compatibility with reporting regimes [14]. This misalignment becomes particularly problematic when algorithmic outputs are incorporated into formal reporting processes without clear procedures for validation or reconciliation.

Figure 7 Screenshot of the article *The Bigger Picture of Climate Change and AI*. *Source:* Earth.org (Soon, 2025)

Empirical analyses of artificial intelligence-supported emissions datasets reveal discrepancies between national inventories and model-generated estimates that can exceed fifteen to twenty percent in certain sectors, particularly land use and agriculture [15]. In several documented cases, algorithmic estimates have been treated as authoritative reference points, placing national reporting institutions in a defensive position despite limited capacity to audit or contest underlying assumptions [16]. These dynamic risks shifting epistemic authority away from nationally accountable institutions toward technical systems operating outside formal governance channels.

The governance gap is also evident in the limited availability of contestability mechanisms for artificial intelligence-enabled decision-support systems. Contestability, understood as the ability of affected actors to challenge, interrogate, or revise decision-making processes, is a foundational principle of democratic governance and administrative accountability [17]. However, empirical reviews of public-sector artificial intelligence deployments indicate that fewer than twenty percent include structured mechanisms for stakeholder challenge, independent audit, or procedural appeal [18]. This absence is particularly problematic in climate governance, where algorithmically informed decisions can shape adaptation priorities, finance allocation, and development trajectories with significant distributive consequences [19].

5. Transparency Beyond Disclosure: Explainability, Traceability, and Contestability in AI-Enabled Climate Governance

Transparency has long been treated as a foundational principle of climate governance, underpinning trust, comparability, and accountability across national and international processes [20]. Within climate reporting architectures, transparency is operationalized through methodological documentation, expert technical review, and the ability of Parties to explain and justify reported data and assumptions [8]. However, the increasing reliance on artificial intelligence–enabled decision-support systems exposes the limitations of prevailing transparency frameworks, which are poorly equipped to address algorithmic forms of knowledge production [21].

In many artificial intelligence applications, transparency is narrowly construed as disclosure of outputs, dashboards, or high-level descriptions of model purpose [22]. While such disclosure may enhance visibility, it does not necessarily provide meaningful insight into how algorithmic systems generate results, how uncertainties are handled, or how normative assumptions are embedded in model design [23]. Empirical studies in algorithmic governance demonstrate that output-level transparency often creates an illusion of openness while leaving decision logic effectively opaque to users and affected stakeholder [10].

Figure 8 Screenshot of the news article Government admits its approval for Buckinghamshire AI datacentre should be quashed. Source: The Guardian, 2026

This limitation is particularly problematic in climate governance contexts, where transparency is not merely informational but procedural and institutional. Climate reporting regimes require that data and analyses be reproducible, reviewable, and subject to technical challenge by peers and oversight bodies [8]. Artificial intelligence systems that rely on complex learning architectures, such as deep neural networks or ensemble models, frequently fail to meet these requirements, even when outputs are publicly accessible [24]. Research indicates that more than two-thirds of machine-learning systems used in environmental analytics lack sufficient documentation to enable independent replication or audit [25].

Explainability therefore emerges as a critical but underdeveloped dimension of transparency in AI-enabled climate decision-support systems. Explainability refers to the capacity to articulate how specific inputs, assumptions, and model structures contribute to outputs in ways that are intelligible to relevant institutional actors [26]. In climate governance, explainability is essential for enabling policymakers, technical experts, and reviewers to understand why certain mitigation pathways are favored, why particular adaptation priorities are ranked highly, or why emissions estimates differ across sources ([27]. Without explainability, algorithmic outputs risk being treated as authoritative without scrutiny, undermining the deliberative foundations of climate policy [12].

Traceability constitutes a second, distinct dimension of transparency that is frequently overlooked in AI governance discussions. Traceability refers to the ability to track data sources, transformations, and decision pathways throughout the lifecycle of an analytical system [28]. In climate reporting, traceability is a core requirement, as Parties must be able to link reported outcomes to underlying activity data, emission factors, and methodological choices [29]. Artificial intelligence systems often disrupt traceability by aggregating heterogeneous datasets, applying automated feature selection, or iteratively updating models in ways that obscure data provenance [30].

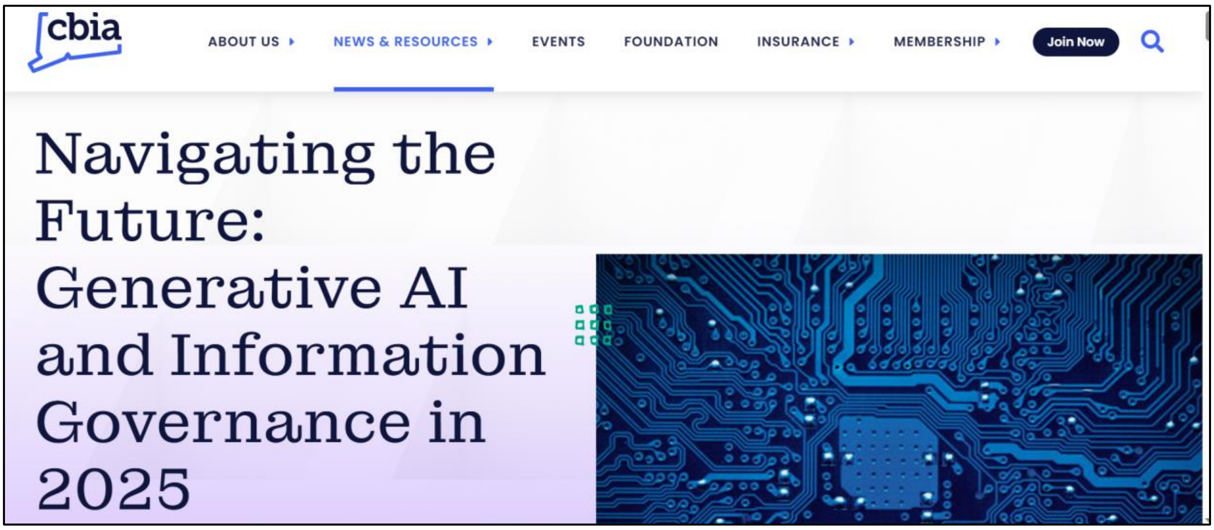

Figure 9 Screenshot of the article Navigating the Future: Generative AI and Information Governance in 2025. Source: Connecticut Business & Industry Association (CBIA), 2025

Empirical evidence highlights the governance risks associated with weak traceability. Studies of AI-supported emissions datasets have shown that discrepancies between model-generated estimates and national inventories are frequently difficult to resolve because underlying data transformations are insufficiently documented [15]. In such cases, national authorities may be unable to explain or defend reported figures during technical review processes, even when they are held accountable for the outcomes [16]. This dynamic erodes the principle of national ownership that underpins international climate transparency frameworks [20].

Contestability represents a third and equally essential dimension of transparency that remains largely absent from AI-enabled climate decision-support systems. Contestability refers to the institutional capacity of affected actors to challenge, question, and seek revision of decisions or recommendations generated by analytical systems [17]. In democratic governance, contestability is a prerequisite for accountability, as it allows errors, biases, and contested assumptions to be surfaced and addressed [31]. However, research indicates that algorithmic systems are rarely designed with formal mechanisms for contestation, particularly when they function as advisory tools rather than legally binding decision-makers [32].

In climate governance, the absence of contestability is especially consequential. AI-enabled systems increasingly inform decisions related to adaptation prioritization, climate finance eligibility, and policy benchmarking, all of which have significant distributive implications [19]. Empirical studies show that algorithmic tools used in development and environmental planning can reproduce historical biases embedded in training data, disproportionately disadvantaging low-capacity regions and marginalized communities [20]. Without institutionalized pathways for challenge and review, such biases may remain invisible and uncorrected, despite their policy significance.

This reconceptualization has direct implications for the design and governance of AI-enabled climate decision-support systems. Systems that are intended to inform policy and reporting must be aligned with the procedural norms of climate governance, including documentation standards, review mechanisms, and clearly defined roles and responsibilities. Transparency, in this sense, is not achieved through openness alone but through institutional arrangements that make algorithmic systems answerable to the governance contexts in which they operate.

6. Toward a Governance Framework for AI-Enabled Climate Decision-Support Systems

Addressing the governance gap identified in preceding sections requires moving beyond abstract calls for ethical artificial intelligence toward a sector-specific governance framework tailored to the institutional realities of climate policy and reporting. Artificial intelligence–enabled climate decision-support systems operate within regulatory, political, and epistemic environments that impose distinct normative requirements, including transparency, accountability, comparability, and procedural legitimacy [20]. A governance framework for such systems must therefore be grounded not in general-purpose AI principles, but in the operational logics of climate governance infrastructures.

A foundational requirement of such a framework is institutional embedding. AI-enabled decision-support systems must be formally situated within existing climate governance architectures rather than operating as external or informal advisory tools [9]. This entails the explicit assignment of institutional ownership, including responsibility for system validation, updating, and oversight, to entities that are already accountable within climate reporting and planning processes [8]. Empirical evidence from public-sector AI deployments indicates that systems with clearly defined institutional custodians are significantly more likely to be subject to audit, documentation, and corrective action than those developed or managed by third-party actors without formal mandates [33].

Closely related is the requirement of role clarity and responsibility allocation across the lifecycle of AI-enabled systems. Climate decision-support systems typically involve multiple actors, including data providers, model developers, system integrators, and policy users, each of whom exerts influence over analytical outcomes [33]. A governance framework must therefore specify decision rights and accountability at each stage, from data selection and preprocessing to model deployment and policy interpretation. Without such clarity, responsibility becomes fragmented, undermining the ability of institutions to respond effectively to errors, bias, or unintended consequences [17].

A second core pillar of the framework is alignment with climate transparency and reporting norms. AI-enabled systems intended to inform mitigation, adaptation, or transparency processes must be designed to comply with established requirements for methodological documentation, reproducibility, and expert review [8]. This implies that system architectures should prioritize traceable data pipelines, documented assumptions, and stable versioning over purely performance-driven optimization [29]. Studies of climate analytics platforms show that systems aligned with reporting standards are more readily integrated into national processes and less likely to generate contestation during technical review [15].

Explainability must also be institutionalized as a governance requirement rather than treated as a discretionary technical feature. Explainability in this context does not demand full interpretability of complex models, but rather the provision of decision-relevant explanations that allow institutional actors to understand the drivers, limitations, and sensitivities of algorithmic outputs [26]. Research demonstrates that explainable systems significantly improve policymakers' capacity to exercise judgment and reduce overreliance on algorithmic recommendations, particularly in high-stakes decision environments [12].

A further element of the governance framework concerns traceability and auditability across system lifecycles. AI-enabled climate decision-support systems evolve through iterative updates, retraining, and data expansion, processes that can fundamentally alter analytical behavior over time [28]. Governance arrangements must therefore require comprehensive audit trails documenting data sources, model versions, parameter changes, and output revisions [28]. Empirical studies indicate that the absence of such traceability is a major barrier to accountability in algorithmic systems used for public decision-making [30].

Contestability must be embedded as a formal institutional mechanism rather than an informal possibility. Systems that influence climate policy outcomes must allow affected actors, including national authorities and technical reviewers, to challenge assumptions, request clarification, and seek revision of outputs [31]. This requires governance procedures that define how contestation is initiated, how challenges are evaluated, and how outcomes are incorporated into system refinement [17]. Evidence from environmental governance shows that contestable decision processes enhance legitimacy and improve substantive outcomes by surfacing overlooked assumptions and contextual knowledge [19].

Capacity considerations constitute an additional, often neglected, dimension of governance design. The uneven distribution of technical expertise and digital infrastructure across countries and institutions creates asymmetries in the ability to engage meaningfully with AI-enabled systems [34]. Governance frameworks must therefore incorporate provisions for capacity-building, technical support, and shared access to system documentation and tools, particularly in the context of international climate reporting [20]. Without such measures, AI-enabled systems risk reinforcing existing inequalities rather than supporting inclusive climate governance.

7. Implications for Climate Policy, Reporting, and Planning

The governance of artificial intelligence–enabled climate decision-support systems has direct and far-reaching implications for the credibility, effectiveness, and legitimacy of climate policy, reporting, and planning. As these systems increasingly mediate how climate data is interpreted and transformed into policy-relevant outputs, weaknesses in their governance do not remain confined to technical domains but propagate through institutional processes, shaping incentives, priorities, and trust relationships at national and international levels [4].

Poorly governed AI-enabled decision-support systems pose a significant risk to the credibility of national climate reporting. Climate transparency frameworks rely on the ability of Parties to explain, justify, and defend reported data and methodological choices during technical expert review processes [18]. When emissions estimates, mitigation trajectories, or progress indicators are derived from algorithmic systems that lack explainability or traceability, national authorities may find themselves accountable for outputs they cannot meaningfully interrogate or reproduce [16]. Empirical evidence from recent inventory reviews indicates that unexplained discrepancies between national reports and model-based datasets can trigger prolonged review processes, erode confidence in reported data, and increase perceptions of non-compliance, even when discrepancies arise from methodological rather than substantive differences [35]. In this way, poorly governed AI-CDSS risk weakening national ownership of reporting processes and undermining the principle of transparency as mutual accountability rather than external surveillance [20].

The implications extend beyond reporting into the domain of adaptation planning, where AI-enabled systems are increasingly used to prioritize risks, rank interventions, and allocate resources. Adaptation decision-support tools often rely on algorithmic aggregation of vulnerability indicators, exposure data, and projected impacts to identify priority regions or sectors [3]. When such systems are poorly governed, opaque weighting schemes and biased training data can systematically distort adaptation priorities, favoring interventions that are more easily quantifiable over those grounded in local knowledge or social vulnerability [4]. Empirical studies have shown that algorithmic vulnerability indices can shift funding priorities away from marginalized communities when governance safeguards are absent, reinforcing existing inequalities rather than reducing climate risk [37]. In such contexts, AI-CDSS may inadvertently reframe adaptation as a technocratic optimization problem rather than a socially negotiated process.

At the international level, poorly governed AI-CDSS threaten to weaken trust in global climate processes. Trust is a foundational element of international cooperation, particularly in regimes that rely on self-reporting, peer review, and collective assessment rather than centralized enforcement [38]. When algorithmic systems are perceived as opaque, externally imposed, or misaligned with national capacities, they can exacerbate North–South tensions and fuel perceptions of technocratic dominance in global climate governance [39]. Evidence from climate data governance debates suggests that developing countries are particularly sensitive to the use of global datasets and models that override national data without transparent reconciliation mechanisms, viewing such practices as challenges to sovereignty and procedural fairness [16]. In this context, AI-CDSS that lack explicit governance arrangements risk becoming sources of contestation rather than instruments of collective learning.

Conversely, well-governed AI-enabled climate decision-support systems hold significant potential to strengthen climate transparency, policy coherence, and institutional trust. When embedded within clear governance frameworks, such systems can enhance the consistency, comparability, and completeness of climate data across reporting cycles, supporting more robust tracking of progress over time [29]. Empirical evidence from digitally enabled inventory systems indicates that automated data integration, when combined with transparent documentation and auditability, can reduce reporting errors and improve timeliness without compromising accountability [39].

In policy planning contexts, well-governed AI-CDSS can support more informed and deliberative decision-making by making complex climate information accessible while preserving opportunities for human judgment and contestation. Studies in policy analytics demonstrate that decision-support systems that explicitly communicate uncertainty, assumptions, and trade-offs improve the quality of policy deliberation and reduce overreliance on model outputs [12]. When explainability and traceability are institutionalized, AI systems can function as boundary objects that facilitate dialogue between technical experts and policymakers rather than as black-box authorities [40].

At the level of global climate governance, the alignment of AI-CDSS with transparency and reporting norms can enhance trust by reinforcing shared standards of review and accountability. Systems designed to support, rather than substitute for, nationally accountable reporting processes can strengthen mutual confidence in reported information and reduce friction during technical expert reviews and global stocktake exercises [40]. Evidence from collaborative data initiatives suggests that co-designed analytical platforms, governed by clear institutional agreements, are more likely to be perceived as legitimate and to support cooperative learning across countries [7].

These implications underscore that the question facing climate governance is not whether artificial intelligence should be used in decision-support systems, but under what governance conditions such use can enhance rather than undermine transparency, credibility, and trust. Poorly governed AI-CDSS risk eroding the institutional foundations of climate policy by introducing opacity, distorting priorities, and weakening confidence in collective processes. Well-governed systems, by contrast, can reinforce climate transparency as a living institutional practice, supporting accountable decision-making in an increasingly data-intensive policy environment. The distinction between these outcomes is not primarily technical, but institutional, reinforcing the central argument of this position paper that governance, rather than innovation alone, must guide the integration of artificial intelligence into climate decision-support infrastructures.

8. Conclusion

Artificial intelligence–enabled climate decision-support systems have crossed a threshold at which they can no longer be treated as auxiliary analytical tools. As these systems increasingly shape emissions estimates, mitigation pathways, adaptation priorities, and reporting narratives, they operate as de facto governance infrastructures whose outputs carry political, distributive, and accountability consequences. Continuing to govern them as technical innovations rather than institutional actors is no longer tenable within climate governance regimes that depend on transparency, comparability, and trust.

Where algorithmic systems influence nationally accountable reporting and policy decisions, the absence of explicit governance arrangements constitutes a structural failure rather than a regulatory gap. Diffused responsibility, opaque decision logic, and misalignment with established reporting architectures weaken the capacity of states and institutions to explain, defend, and justify climate decisions. In such conditions, accountability becomes performative rather than substantive, and transparency risks being reduced to disclosure without scrutiny. This erosion is not abstract. It directly affects the credibility of national reports, the legitimacy of adaptation planning, and confidence in collective climate processes that rely on mutual verification rather than enforcement.

Transparency in this context cannot be sustained through visibility alone. When algorithmic systems filter data, encode assumptions, and prioritize policy options, transparency must function as an enforceable institutional condition. Explainability, traceability, and contestability are not matters of design preference but prerequisites for legitimate climate governance. Without them, artificial intelligence assumes epistemic authority without corresponding responsibility, insulating decision logic from review, and undermining the procedural norms that distinguish governance from technocratic administration.

The implications of failing to govern AI-enabled climate decision-support systems are cumulative and systemic. Poorly governed systems distort adaptation priorities by privileging quantifiable risks over contextual vulnerability. They weaken national ownership of reporting processes by substituting algorithmic proxies for accountable judgment. They strain international trust by introducing opaque benchmarks into regimes built on negotiated transparency. Each of these effects compounds the others, reinforcing a trajectory in which climate governance becomes increasingly data-driven yet institutionally hollowed.

Responsibility for addressing these failures cannot be deferred or displaced. States that rely on algorithmic systems in reporting and planning remain accountable for their outputs, regardless of whether those systems are developed internally or procured externally. International institutions that promote or deploy AI-enabled analytical platforms assume responsibility for their alignment with transparency norms and review procedures. System designers and data providers cannot claim neutrality when their technical choices shape policy outcomes within governance frameworks. The diffusion of responsibility that currently characterizes AI-CDSS deployment is itself a governance failure that must be corrected.

The central question confronting climate governance is therefore not whether artificial intelligence will continue to shape decision-making, but whether its integration will be governed in ways that preserve institutional credibility and democratic legitimacy. Treating AI-enabled climate decision-support systems as governance infrastructures demands explicit institutional design, clear accountability, and enforceable transparency conditions. Absent such measures, artificial intelligence risks undermining the very foundations of climate policy and cooperation it is increasingly invoked to support.

This is not a call for caution, nor for restraint in the use of computational tools. It is a recognition that climate governance has entered a phase in which algorithmic systems exercise power. Power exercised without governance erodes legitimacy. Power embedded within accountable institutions sustains it. The choice between these trajectories is no longer theoretical. It is already being made, implicitly, through the continued deployment of AI-enabled systems without corresponding governance. Reversing that trajectory requires treating governance not as an afterthought to innovation, but as its necessary condition.

Compliance with ethical standards

Disclosure of conflict of interest

The Authors proclaim no conflict of interest.

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