# Governing Environmental Decisions with Artificial Intelligence: Algorithmic Sustainability for Accountability and Lifecycle Impact, a Policy Review

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# Governing Environmental Decisions with Artificial Intelligence: Algorithmic Sustainability for Accountability and Lifecycle Impact, a Policy Review

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**Abstract**

Artificial intelligence is increasingly incorporated into public environmental decision-making processes, directing the classification of risks, the distribution of resources, and the implementation of regulatory measures. Current policy discussions tend to emphasize predictive performance and ethical principles. Institutional conditions play a lesser role in determining the decision authority of algorithm-generated outputs. This policy review bridges this gap by examining environmental artificial intelligence as part of administrative decision processes rather than as neutral analytical software. Building on recent work on algorithmic sustainability, the review assesses how existing governance instruments engage with lifecycle environmental impacts, organizational responsibility, and procedural legitimacy. The analysis of international frameworks indicates that transparency and risk-based governance are receiving increasing attention, particularly in relation to their effectiveness in addressing environmental concerns and ensuring accountability in AI applications. At the same time, lifecycle environmental impacts remain weakly integrated into decision justification and oversight, which undermines the effectiveness of governance frameworks in addressing the environmental impacts associated with AI technologies. To overcome this limitation, the paper proposes a way of examining how artificial intelligence is integrated into decision processes. The results show that effective governance depends on aligning institutional design with sustainability objectives at the points where algorithmic outputs affect public decisions.

**Keywords:** environmental governance; artificial intelligence; algorithmic sustainability; policy design; decision-making infrastructure

## 1. The Governance Gap in Environmental Decision-Making with Artificial Intelligence

Artificial intelligence is increasingly used by public authorities in environmental decision-making. Its application extends across climate risk assessment, land-use planning, environmental monitoring, and regulatory enforcement. In many cases, these systems do not remain at the level of technical support. They shape how risks are defined, how priorities are set, and how decisions are carried out within administrative processes. This shift matters. It shows the need to deal with complex information under conditions of uncertainty and time constraints.

However, current governance approaches have not fully adapted to this development. While policy discussions tend to emphasize predictive performance and general ethical judgments, less attention is given to how algorithmic outputs become embedded in decision processes and begin to influence the exercise of public authority. Two areas illustrate this gap. One concerns the environmental implications associated with artificial intelligence, including energy use, emissions, and infrastructure dependencies across the lifecycle of systems [1–3]. The other concerns the conditions under which decisions are shaped by algorithmic outputs, including questions of accountability, transparency, and access to review [1,4].

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Recent work on algorithmic sustainability provides a useful point of reference for interpreting these issues [5]. Rather than treating sustainability as a characteristic of technical performance, this perspective directs attention to how environmental impacts, institutional responsibility, and societal trust are managed when artificial intelligence is used in decision-making.

While this review does not develop the concept further, it instead uses it to examine how governance operates in practice. The scale of digital infrastructure reinforces the urgency of this challenge. Data centers account for a significant share of electricity consumption, and demand is expected to increase as artificial intelligence systems expand (International Energy Agency, 2025). At the same time, regulatory structures rarely require systematic consideration of these impacts when such systems are deployed in environmental contexts [3]. The result is a misalignment. Systems may improve efficiency while generating environmental pressures that remain insufficiently addressed.

The central issue is institutional: how should decision authority be structured, responsibility assigned, and impacts evaluated when artificial intelligence becomes part of environmental governance? Clarifying these aspects is important to ensure AI enhances, rather than undermines, responsible environmental decision-making. Under what conditions can these systems support decision-making without weakening institutional accountability?

This review does not seek to define new analytical tools. It focuses on how institutional arrangements shape the use of artificial intelligence in environmental decision-making.

*a. Approach*

This policy review assesses how existing governance frameworks address the use of artificial intelligence in public environmental decision-making. The analysis focuses on international policy instruments, regulatory frameworks, and institutional guidelines published between 2020 and 2025. Sources were selected based on their relevance to public-sector use of artificial intelligence, their treatment of governance and accountability, and their consideration of environmental impacts.

Rather than evaluating technical performance, the review adopts an institutional perspective. It considers how decision authority is structured when artificial intelligence influences public decisions. It also examines whether environmental impacts, including energy use, emissions, and infrastructure dependencies, are addressed within governance processes. The aim is to identify gaps between current policy approaches and the requirements for responsible use of artificial intelligence in environmental settings. On this basis, the paper advances a coherent approach to assessing artificial intelligence within environmental decision-making procedures. The focus is on how governance can be organized in practice rather than on developing new conceptual models.

## 2. Evidence Base for Governing Environmental AI

Research on climate policy and environmental governance indicates that artificial intelligence affects outcomes beyond immediate application performance. Energy demand associated with model training, as well as the continued use of systems at scale, results in environmental pressure over time [1]. In addition, system expansion may alter patterns of resource use in ways that are not immediately visible at the point of deployment. Within public administration, artificial intelligence is often used to translate data into operational categories. These include risk zones, inspection priorities, and thresholds that guide regulatory action. Once embedded in administrative processes, such classifications influence how decisions are implemented. This influence does not depend on formal authority alone. It emerges through repeated use within institutional routines.

The consequences are not limited to efficiency gains. In some cases, augmented computational demand contributes to higher energy use. In others, decision pathways become less transparent when classification processes are difficult to interpret. Questions of review and accountability arise when affected parties cannot easily challenge or understand outcomes [1,4].

International governance instruments have begun to address aspects of these concerns. The Organisation for Economic Co-operation and Development principles for artificial intelligence and UNESCO both emphasize accountability and human oversight [6,7]. Regulatory developments

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within the European Union introduce requirements that vary according to the level of risk associated with different uses of artificial intelligence [8]. These measures represent important steps.

However, a gap remains. Present approaches tend to concentrate on procedural safeguards and risk classification. Less attention is given to the environmental implications associated with the lifecycle of systems. Energy use, emissions, and infrastructure dependencies are not consistently incorporated into decision justification or oversight [3]. As a result, systems may meet governance requirements while resulting in environmental pressures that remain insufficiently examined. This evidence suggests that current approaches address individual elements of the problem. They do not yet provide a consistent way of linking environmental impacts, institutional responsibility, and decision processes within a single governance perspective. These differences can be clarified through a comparison of current governance approaches and the policy gaps identified in this review, as shown in Table 1.

**Table 1.** Comparison of current governance approaches and identified policy gaps in AI-mediated environmental decision-making.

| Governance Aspect | Current Policy Focus | Observed Limitation | Policy Gap Identified |
|---|---|---|---|
| Transparency and clarity | Emphasis on interpretability of algorithmic outputs | Focus remains on technical transparency rather than decision context | Limited attention to how outputs influence administrative decisions |
| Risk-based governance | Classification of AI systems according to risk levels | Risk categories do not fully reflect environmental implications | Weak integration of lifecycle environmental impacts |
| Accountability mechanisms | Human oversight and responsibility allocation | Oversight often remains procedural and not operational | Limited capacity to trace how decisions are shaped in practice |
| Environmental considerations | Emerging recognition of energy use and emissions | Environmental impacts treated separately from governance processes | Lack of integration between lifecycle impacts and decision-making |
| Institutional capacity | Recognition of need for technical expertise and infrastructure | Uneven readiness across institutions | Insufficient alignment between governance requirements and institutional capability |

## 3. From Evidence to Governance Action

The evidence discussed above indicates that the challenge of governing artificial intelligence in environmental settings is not primarily technical. It derives from the way these systems become embedded in decision processes and begin to shape how public authority is exercised. When outputs are translated into classifications, priorities, or thresholds, they influence administrative action. This influence develops through use, not only through formal designation.

In practice, many governance approaches remain focused on system performance or general principles. These include data quality requirements, transparency measures, and ethical guidance. While these elements are important, they do not fully address how decision authority is structured once artificial intelligence becomes part of institutional routines. A gap emerges between how

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systems operate and how they are governed. The implications are significant. Unlike technical approaches that focus on model performance, this perspective examines how decisions are shaped within institutional settings.

This gap is reflected in the way responsibility is assigned. Accountability mechanisms are often designed around human decision-makers, even when outcomes are shaped by algorithm-driven processes. At the same time, environmental impacts associated with system deployment are rarely integrated into decision justification. The result is a form of partial oversight, where some aspects are regulated while others remain outside formal consideration [3,4].

Recent policy developments imply movement in this direction. Risk-based approaches and ethical guidance emphasize proportional oversight and the need for safeguards where impacts are significant [6–8]. However, these approaches do not yet provide a consistent way to connect environmental impacts, institutional responsibility, and decision processes in practice. A shift is therefore required. Governance must connect directly with the points at which artificial intelligence influences decisions. This includes conditions before systems are deployed, as well as mechanisms that operate during their use. Attention needs to shift from abstract principles to the organization of decision-making operations within institutions.

This is the central issue. When algorithmic outputs begin to shape outcomes, who remains accountable for the decisions that follow? It concerns how authority is structured, how responsibility is maintained, and how impacts are assessed when artificial intelligence becomes part of environmental governance.

## 4. A Governance Approach to Assessing Artificial Intelligence in Environmental Decision-Making

Addressing the governance gap requires attention to how decision processes are structured within institutions when artificial intelligence is used. The focus is not limited to system performance. It extends to how decisions are shaped, how impacts are considered, and how responsibility is maintained within institutional processes.

In this context, assessment is understood as part of institutional governance rather than as a separate technical operation. When artificial intelligence is used in environmental decision-making, it becomes necessary to examine how it contributes to administrative outcomes. This includes clarifying the role of the system within the decision process and identifying the conditions under which its outputs are used.

A first consideration concerns decision authority. In some cases, outputs provide information that supports human assessment. In others, they are used to structure priorities or guide action in a more direct way. The distinction matters because the level of influence affects the degree of oversight required. Where systems shape outcomes more strongly, expectations regarding accountability and review become more demanding.

A second consideration relates to environmental implications. Artificial intelligence systems require resources throughout their lifecycle. This includes energy use during development and operation, as well as infrastructure that supports continued deployment. These impacts are often considered separately from decision-making activities. Integrating them into governance allows a more complete evaluation of how systems affect environmental outcomes [1,3].

A further consideration concerns procedural conditions. Decisions that are influenced by artificial intelligence need to remain understandable and open to review. This includes the ability to explain how outcomes are produced, as well as the possibility for affected parties to question or challenge those outcomes. Human oversight is still essential in this context, particularly where decisions have significant consequences.

Assessment, in this sense, is not a one-time requirement. It needs to continue over time as systems are updated, scaled, or applied in new settings. Changes in data, context, or use can change both impacts and risks. Governance, therefore, requires mechanisms that allow for periodic review and adjustment.

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This approach does not introduce a separate framework. It situates assessment within existing decision processes. By linking decision authority, environmental implications, and procedural conditions, it provides a way to organize governance in practice. The aim is to ensure that artificial intelligence is used in a manner that remains accountable, transparent, and consistent with environmental objectives.

## 5. From Principles to Practice

Translating institutional governance principles into practice requires more than general guidance. Implementation depends on how rules, procedures, and standards are incorporated into administrative systems. Without this integration, commitments related to accountability or sustainability remain difficult to apply consistently. Standardization plays an important role in this process. Established approaches to lifecycle assessment provide a basis for examining environmental impacts associated with artificial intelligence. These include energy use, emissions, and resource dependencies that extend beyond immediate system operation [3]. When such approaches are aligned with governance requirements, they allow impacts to be evaluated in a manner that is comparable across systems and over time. In practice, this requires integration with existing administrative procedures such as permitting, inspection regimes, and regulatory reporting.

Operational oversight also depends on the use of measurable indicators. In the context of digital infrastructure, metrics such as energy efficiency and resource use can provide insight into how systems perform during deployment. These indicators become relevant when artificial intelligence is used continuously or at scale, as their effects accumulate within institutional settings.

Institutional arrangements are equally important. Governance requires procedures that make it possible to trace how outputs are used within decision processes. This includes documentation of data sources, model development, and points at which human assessment is exercised. Where impacts are significant, additional forms of review may be necessary to ensure that decisions remain accountable [9].

Monitoring over time is essential. Artificial intelligence systems do not remain static. Their use may expand, and their effects may change as situations develop. Periodic review allows institutions to identify shifts in impact and to adjust institutional governance measures accordingly. Without such mechanisms, initial assessments may lose relevance.

Implementation also depends on institutional capacity. Differences in technical expertise and regulatory resources affect how governance can be applied in practice. Coordination across jurisdictions can support the exchange of knowledge and the development of shared approaches. This contributes to more consistent application while allowing for adaptation to local conditions [10]. Taken together, these elements indicate that competent governance depends on how principles are embedded within institutions. The challenge is not only to define appropriate standards, but to ensure that they can be applied, monitored, and revised over time.

## 6. Policy Recommendations and Action Points

Translating governance into practice requires a set of actions that can be implemented within existing institutional structures. The following recommendations are directed toward public authorities responsible for the use and oversight of artificial intelligence in environmental decision-making.

Public institutions need to treat artificial intelligence as part of decision-making processes rather than as an external technical tool. This requires coordination between procurement, regulatory oversight, and operational policy. When these elements are addressed separately, accountability and environmental evaluation gaps emerge [6,7].

A distinction should be made between the different roles that artificial intelligence can play in decision processes. Some systems provide information that supports human decision-making, while

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others shape priorities or guide action more directly. Institutional governance requirements need to reflect these differences. Where influence is greater, oversight should be more demanding [8].

Assessment of artificial intelligence should be integrated into decision processes from the outset and continue over time. This includes examining how systems are used, how their impacts evolve, and how responsibility is maintained. Periodic review becomes necessary when systems are modified or applied in new contexts [11].

Environmental implications need to be addressed in a consistent manner. This requires attention to energy use, emissions, and infrastructure dependencies across the lifecycle of systems. When such impacts are not considered, environmental benefits may be overstated or incomplete [3].

Accountability depends on the ability to trace how decisions are formed. Institutions ought to maintain documentation that makes it possible to reconstruct how outputs have been used within decision processes. Where impacts are significant, an independent review can provide an additional layer of assurance [9].

Decisions influenced by artificial intelligence should remain open to review. This includes supplying clear explanations of how outcomes are produced and making sure that affected parties can question those outcomes. Human judgement remains central in this context, particularly where consequences are substantial [6,7].

Governance measures should be proportionate to the level of influence and impact associated with each system. This allows institutions to focus resources where they are most needed while maintaining a baseline level of oversight across all applications.

Capacity remains a limiting factor in many contexts. Strengthening technical expertise and institutional coordination can support more effective governance. Cooperation across jurisdictions contributes to the development of shared practices while allowing for adaptation to different regulatory contexts [10].

## 7. Conclusion

Artificial intelligence is becoming embedded within environmental governance, where it influences how decisions are formed and implemented. Its use extends beyond technical analysis. It affects how risks are defined, how priorities are set, and how regulatory actions are carried out within institutional contexts. This review has identified a gap between current governance approaches and the conditions required to manage these developments effectively. Existing frameworks give attention to transparency and risk management. Less emphasis is placed on how environmental impacts, decision authority, and accountability are connected within decision processes. As a result, important aspects of governance remain only partially addressed.

The analysis has shown that this gap is institutional. It results from the way artificial intelligence is integrated into administrative systems and from how responsibility is assigned and maintained. When environmental implications are not considered alongside decision processes, outcomes may appear effective while broader impacts remain insufficiently examined. Tackling this issue requires a shift in focus.

Governance needs to engage with the points at which artificial intelligence influences decisions and with the conditions under which those decisions are made. This includes attention before systems are deployed as well as during their continued use. The central question is not whether artificial intelligence should be used in environmental decision-making. It concerns how its use can be organized in a manner that remains accountable, transparent, and consistent with environmental objectives. The answer depends on institutional design. The stakes are high. Can governance systems keep pace with the growing influence of artificial intelligence on environmental decisions?

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**Use of Generative Artificial Intelligence:** During the preparation of this manuscript, the authors used generative AI tools, including ChatGPT, QuillBot, and Grammarly, exclusively for language refinement, grammar correction, structural editing, and limited translation support. In addition, professional editing or translation services that may employ AI-assisted tools were used solely for linguistic improvement. These tools were not used to conduct statistical analysis, perform simulations, develop methodological decisions, or create references. All scientific content, interpretations, and conclusions were developed, critically reviewed, and validated by the authors.

## Abbreviations

The following abbreviations are used in this manuscript:

| | |
|---|---|
| AI | Artificial Intelligence |
| EU | European Union |
| GHG | Greenhouse Gas |
| IEA | International Energy Agency |
| LCA | Life Cycle Assessment |
| NIST | National Institute of Standards and Technology |
| OECD | Organization for Economic Co-operation and Development |
| UN | United Nations |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |

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