

THE "COUNTER-MAJORITARIAN DIFFICULTY" OF CLIMATE MODELS: JUDICIAL REVIEW AND EPISTEMIC AUTHORITY IN THE AGE OF THE ANTHROPOCENE

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ABSTRACT:

The legitimacy of constitutional review has long been debated through the lens of the "counter-majoritarian difficulty." Climate change litigation intensifies this perennial problem, as courts are increasingly asked to intervene in complex policy areas based on scientific projections rather than traditional legal materials. This article argues that the use of climate models by courts presents a novel and deeper challenge to the separation of powers. When a court accepts a climate model's carbon budget as a constraint on state action, it does not simply check the majority; it subordinates democratic decision-making to the authority of a computational algorithm. Drawing on the emerging framework of "computational constitutionalism," this article analyzes how judicial reliance on models like those from the Intergovernmental Panel on Climate Change can effectively "constitutionalize" a specific scientific methodology, pre-structuring the outcomes of constitutional reasoning without explicit normative justification. This move subtly redefines the separation of powers by transferring epistemic authority from the political branches to the judicial branch, which then delegates factual authority to climate science. The article explores this dynamic through the lens of recent case law, including *KlimaSeniorinnen v. Switzerland*, where a carbon budget became a benchmark for human rights compliance, and contrasts it with the more cautious approach of the Dutch appellate court in *Milieudefensie v. Shell*. It concludes by proposing procedural safeguards and interpretive principles to maintain judicial legitimacy and democratic integrity while engaging with scientific expertise.

Keywords: Computational Constitutionalism, Climate Change Litigation, Separation of Powers, Counter-Majoritarian Difficulty, Climate Models, Carbon Budgets, Judicial Review, Constitutional Legitimacy, Climate Justice, Scientific Evidence, Democratic Accountability, Human Rights.

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I. INTRODUCTION

The relationship between constitutional courts and democratic legislatures has long been characterised by a fundamental tension. Alexander Bickel famously framed this as the "counter-majoritarian difficulty": the apparent paradox that unelected judges may invalidate the acts of elected representatives, thereby thwarting the will of the majority. Climate change litigation, which has proliferated across jurisdictions in recent years, intensifies this difficulty in ways that legal scholarship has only begun to apprehend. Courts are now asked to adjudicate the adequacy of national

emissions reduction policies, to determine the permissible pace of decarbonisation, and to specify concrete obligations for both states and corporations. In doing so, they are not merely applying traditional constitutional doctrines; they are engaging with scientific models that project future climate scenarios, quantify remaining carbon budgets, and assign probabilities to various warming trajectories.

This engagement with climate science is not, in itself, unprecedented. Courts have long relied on expert evidence when adjudicating environmental harm. What distinguishes the current wave of

climate litigation is not the use of scientific evidence as such, but rather the manner in which computational models have come to structure the very architecture of constitutional reasoning. When a court accepts a remaining carbon budget calculated by climate models as a constraint on state action, it adopts a framework that already contains within it assumptions about risk tolerance, distributive justice, intergenerational equity, and the permissible pace of political action. These assumptions rarely appear as explicitly contested normative choices. They enter constitutional law quietly, under the sign of scientific necessity rather than democratic justification.

This article examines the constitutional implications of this phenomenon, which has been described as "computational constitutionalism": a mode of adjudication in which algorithmic and model-based limits migrate from the domain of policy coordination into the domain of constitutional constraint. The central argument is that the judicial use of climate models presents a novel challenge to the separation of powers that goes beyond the traditional counter-majoritarian concern. When courts accept computational projections as legally determinative, they do not merely invalidate legislative choices; they effectively transfer epistemic authority from the political branches to scientific institutions, and from democratic deliberation to algorithmic calculation. This transfer of epistemic authority subtly reconfigures the constitutional division of labour, limiting legislative and executive discretion not through conventional proportionality balancing, but through the imposition of an "epistemic ceiling" that pre-structures what outcomes remain legally conceivable.

The article proceeds in three parts. Part II elaborates the concept of computational constitutionalism and its implications for the separation of powers. Part III examines two contrasting judicial approaches to climate models: the European Court of Human Rights' decision in *Verein KlimaSeniorinnen v. Switzerland*, which treated a carbon budget as a benchmark for human rights compliance, and the Dutch appellate court's judgment in *Milieudefensie v. Shell*, which affirmed a duty of care but declined to impose a specific reduction percentage. Part IV proposes procedural safeguards and interpretive principles to guide courts in navigating the tension between democratic legitimacy and scientific expertise.

II. Computational Constitutionalism and the Separation of Powers

A. The Concept of Computational Constitutionalism

The term "computational constitutionalism" captures a significant transformation in contemporary constitutional adjudication. It refers to the phenomenon whereby courts rely on computational models and algorithmic projections not merely as evidence, but as structuring frameworks that shape the normative content of constitutional duties. This usage differs from existing discussions of algorithmic or digital constitutionalism in technology governance, which focus on platform rules or automated decision-making. In the climate context, the relevant computational artefacts include carbon budgets, emissions pathways, risk curves, attribution models, and probabilistic projections of future climate impacts.

What distinguishes computational constitutionalism from traditional forms of judicial reliance on expertise is the manner in which these models pre-structure the legal universe within which constitutional judgment takes place. Once a court accepts a remaining carbon budget, a peak-emissions timeline, or a probabilistic attribution model, it adopts a framework that already contains within it assumptions about risk tolerance, distributive justice, and the permissible pace of political action. These assumptions enter constitutional law under the sign of necessity rather than justification. The normative work performed by climate models is thus not merely evidentiary; it is constitutive of constitutional meaning.

This phenomenon is particularly evident in the jurisprudence of the European Court of Human Rights. In *KlimaSeniorinnen*, the Court used Intergovernmental Panel on Climate Change-based temperature pathways and risk projections to determine when the state's positive obligations under Article 8 of the European Convention on Human Rights were triggered. Foreseeability and imminence, traditionally legal categories, were derived from model-based assessments of future heat-related mortality. Probabilistic projections were thus translated into present constitutional necessity.

B. The Epistemic Dimension of the Separation of Powers

The separation of powers is conventionally understood as a distribution of governmental functions among legislative, executive, and judicial branches. This distribution has a largely neglected epistemic dimension: it allocates not only authority to act, but also authority to know and to decide what counts as knowledge. The legislative branch is tasked with making policy choices based on the information available to it; the executive branch implements those choices through specialised expertise; the judicial branch resolves disputes by applying legal norms to facts.

Climate change litigation disrupts this epistemic division of labour in two ways. First, courts are required to adjudicate claims that challenge the adequacy of legislative and executive responses to climate change. This requires them to assess whether political branches have acted consistently with scientific consensus, a task that inevitably draws courts into the assessment of scientific validity. Second, courts are asked to specify what would constitute an adequate response, which requires them to engage with climate models that project future scenarios and quantify remaining emissions budgets. In doing so, courts are not merely checking political branches against legal norms; they are also checking them against scientific assessments of what the future requires.

The epistemic dimension of this dynamic is crucial. When a court accepts a climate model's carbon budget as a constraint on state action, it subordinates democratic decision-making to the authority of a computational algorithm. The court does not simply check the majority; it transfers epistemic authority from the political branches, which are accountable to the electorate, to the judicial branch, which then delegates factual authority to climate science. This transfer of epistemic authority has profound implications for the separation of powers, as it constrains legislative and executive discretion not through conventional proportionality balancing, but through the imposition of an "epistemic ceiling" that pre-structures what outcomes remain legally conceivable.

C. The Counter-Majoritarian Difficulty Reconfigured

The traditional counter-majoritarian difficulty concerns the legitimacy of judicial review in a democratic system. The concern is that unelected

judges, insulated from popular accountability, may overturn the decisions of elected representatives. Climate change litigation intensifies this difficulty by expanding the scope of judicial intervention into policy areas that have traditionally been reserved for the political branches. Yet the use of climate models introduces a further complication: it suggests that the judicial branch is not merely substituting its own normative preferences for those of the legislature, but is instead substituting the preferences embedded in scientific models.

This reconfiguration of the counter-majoritarian difficulty has been observed in the German context, where the Federal Constitutional Court's climate judgment has been described as "a tragic choice between democracy today and liberty tomorrow." The German Court found that the legislature's failure to specify emissions reductions beyond 2031 violated fundamental rights, thereby holding the legislature accountable to its own international commitments. In reaching this conclusion, the Court entangled constitutional and international commitments, treating the Paris Agreement's temperature target as lending constitutional force to the legislative target of capping temperature rise at below 2 degrees Celsius.

The German Court's approach illustrates the manner in which international commitments can serve to mitigate the counter-majoritarian difficulty. By pointing to the legislature's own adoption of the Paris Agreement targets, the Court could argue that it was holding the legislature accountable to its own commitments rather than imposing external constraints. Yet this move merely displaces the difficulty: the international commitments themselves are products of intergovernmental negotiation, not of democratic deliberation at the national level. The Court's reliance on international commitments thus raises questions about the democratic legitimacy of the standards it applies.

III. Judicial Approaches to Climate Models in Comparative Perspective

A. The European Court of Human Rights: *KlimaSeniorinnen v. Switzerland*

The European Court of Human Rights' judgment in *Verein KlimaSeniorinnen v. Switzerland* represents the most ambitious judicial engagement with climate models to date. The Court found that Switzerland had violated Article 8 of the European Convention on Human Rights by failing to adopt adequate measures to combat climate change. In

reaching this conclusion, the Court articulated a set of regulatory obligations that included the specification of a national carbon budget consistent with the goal of limiting global warming to 1.5 degrees Celsius.

The Court's reasoning relied heavily on scientific assessments of remaining carbon budgets. It held that states have a reduced margin of appreciation with respect to "the setting of the requisite aims and objectives" for climate mitigation, although they retain a wide margin of appreciation "in respect of the choice of means designed to achieve those objectives ." This distinction is significant: the Court effectively constitutionalised the scientific framework of carbon budgeting while leaving states some discretion in how to implement it .

The Court further specified that states must "adopt general measures specifying a target timeline for achieving carbon neutrality and the overall remaining carbon budget for the same time frame" or an equivalent method of quantifying future greenhouse gas emissions. This obligation to quantify a carbon budget has given rise to a spectrum of interpretations . Some scholars have emphasised the procedural character of the requirement, viewing it as a mechanism to assist states in accounting for their own goals rather than imposing a substantive constraint. Others have concluded that the requirement has a significant substantive dimension, requiring states to quantify their carbon budget as a fair share of the remaining global carbon budget .

The implementation of the KlimaSeniorinnen judgment has proved contentious. Switzerland's action report, submitted to the Committee of Ministers, calculated emissions based on existing policies rather than defining a national carbon budget based on best available science. The Swiss figure of 620 million tonnes of greenhouse gas emissions for the period 2021 to 2050 was said to represent 0.33 percent of the remaining global budget for 1.5 degrees Celsius, although Switzerland represents only 0.11 percent of the global population. Scientists have confirmed that Switzerland's planned emissions will far exceed any national budget that could be derived from the remaining global budget .

The KlimaSeniorinnen judgment thus illustrates the full force of computational constitutionalism. The Court treated a carbon budget, derived from climate models, as a benchmark for human rights compliance. This move effectively transferred

epistemic authority from the political branches to the scientific community, and from democratic deliberation to algorithmic calculation. Yet the Court's reasoning also showed awareness of the separation of powers concerns: by distinguishing between the setting of objectives and the choice of means, the Court attempted to respect the primary role of the political branches while still imposing a constitutional constraint.

B. The Dutch Courts: Milieudefensie v. Shell

The Milieudefensie v. Shell litigation in the Netherlands offers a contrasting approach to the judicial use of climate models. In 2021, the District Court of The Hague ordered Shell to reduce its global carbon dioxide emissions, including Scope 3 emissions, by 45 percent by 2030 . The decision translated climate science into a concrete legal command by treating emissions pathways as determinative of the scope of corporate responsibility. Scientific models supplied the metric through which lawful corporate conduct was defined.

However, this approach was partially reset by the Hague Court of Appeal in November 2024. While the Court affirmed that Shell bore a duty of care to address the risks of dangerous climate change, it declined to impose a specific reduction target . Fixing a precise emissions pathway, the Court held, exceeded the proper judicial role and belonged to the domain of political and legislative determination. The appeal thus did not reject the relevance of climate science but resisted the move from scientific projection to binding judicial command.

The constitutional significance of the appellate judgment lies in this hesitation. The Court accepted that climate risk can ground legal responsibility, yet it drew a boundary around the authority of courts to convert computational metrics into enforceable obligations . Emissions models remained central to defining the problem, but not to dictating the solution . In this sense, Shell exposes a fault line within computational constitutionalism: courts may rely on scientific frameworks to structure legal reasoning while simultaneously denying those frameworks the power to conclusively determine constitutional outcomes without further normative justification.

The divergence between the two jurisdictions is instructive. The European Court of Human Rights, in KlimaSeniorinnen, treated a carbon budget as a

constitutional benchmark; the Dutch appellate court, in *Shell*, treated scientific models as relevant but not determinative. This divergence reflects differing views of the proper judicial role in climate governance. The European Court saw itself as fulfilling a protective function, ensuring that states honour their human rights obligations. The Dutch appellate court saw itself as respecting the institutional competence of the political branches, even while acknowledging the urgency of climate action.

C. The Implications for Judicial Legitimacy

Read together, *KlimaSeniorinnen* and *Shell* point to a deeper transformation in constitutional reasoning. What is changing is not the evidentiary role of climate science, but the location of constitutional justification. Courts increasingly reason from externally defined limits, such as carbon budgets and emissions thresholds, rather than from internally articulated balances between competing constitutional values. In this mode of adjudication, constitutional judgment is exercised less through proportionality or reason-giving, and more through the acceptance of epistemic ceilings that pre-structure what outcomes remain legally conceivable.

This transformation raises fundamental questions about judicial legitimacy. The counter-majoritarian difficulty is not merely a concern about democratic accountability; it is also a concern about the epistemic authority of courts. If courts are substituting scientific judgments for democratic choices, they may be exceeding their institutional competence. Courts are not designed to adjudicate complex scientific questions; they are designed to resolve legal disputes. When courts treat scientific models as legally determinative, they risk importing assumptions about risk tolerance and distributive justice that have not been subjected to democratic deliberation.

The leading defences of climate adjudication are, to a significant extent, outcome-dependent. They are justified only by assuming that the cause is right, so that the same reasoning would license courts to override democratic majorities for ends far less benign. The juridification of climate policy thus risks undermining both democratic legitimacy and judicial authority itself.

IV. Procedural Safeguards and Interpretive Principles

A. Maintaining Judicial Restraint

The concerns outlined above do not imply that courts should abstain entirely from climate litigation. The urgency of climate change, the inadequacy of political responses, and the severity of the harms at stake all provide compelling reasons for judicial engagement. Yet courts must exercise this engagement with institutional humility, acknowledging their epistemic limits while fulfilling their duty to protect fundamental rights.

One approach is to adopt a "weak-form" review that leaves significant discretion to political branches. This is the approach suggested by the European Court of Human Rights in *KlimaSeniorinnen*: the Court specified the need for a carbon budget but left the choice of means to states. The distinction between setting objectives and choosing means is crucial. Courts can require that states set objectives consistent with human rights obligations, but they should defer to states on the means of achieving those objectives. This approach respects the separation of powers while still providing a constitutional floor.

However, the distinction between objectives and means is not always clear-cut. A carbon budget is both an objective and a means: it specifies the quantity of emissions that must be reduced, which in turn constrains the choice of policies. The Swiss experience illustrates this ambiguity: Switzerland claimed that its existing policies constituted an implicit carbon budget, but critics argued that this was merely a declaration of intent that ignored the remaining global carbon budget. The difficulty of distinguishing objectives from means suggests that courts must exercise particular care in specifying what they require.

B. Procedural Safeguards

Procedural safeguards can help to ensure that courts engage with climate science in a manner that respects democratic legitimacy. One such safeguard is the requirement that states provide reasoned justifications for their climate policies, supported by the best available science. This requirement, which is implicit in the *KlimaSeniorinnen* judgment, ensures that states cannot simply ignore scientific evidence. It also creates a record that courts can review, allowing for meaningful scrutiny without substituting judicial for political judgment.

Another safeguard is the requirement that courts articulate the normative assumptions underlying their reliance on scientific models. When a court accepts a carbon budget, it should explain why that particular budget, rather than an alternative, is constitutionally relevant. This explanation should address the assumptions about risk tolerance, distributive justice, and intergenerational equity that are embedded in the model. By making these assumptions explicit, courts can subject them to scrutiny and debate, rather than allowing them to enter constitutional reasoning without justification.

A third safeguard is the recognition of a margin of appreciation that is wider for political judgments than for scientific judgments. This is the approach adopted by the European Court in *KlimaSeniorinnen*: states have a reduced margin of appreciation for the setting of objectives, but a wide margin for the choice of means. This distinction respects the institutional competence of political branches while still imposing a constitutional constraint. However, as noted above, the distinction requires careful application.

C. Interpretive Principles

Beyond procedural safeguards, courts should adopt interpretive principles that guide their engagement with climate science. One such principle is that climate models should be treated as advisory rather than determinative. This is the approach suggested by the Dutch appellate court in *Shell*: scientific models are relevant to defining the problem, but they do not dictate the solution. Courts should use models to inform their reasoning, not to substitute for it.

Another principle is that courts should seek to articulate constitutional duties in terms that are both meaningful and respectful of political discretion. The European Court's requirement that states quantify a carbon budget is meaningful because it imposes a concrete obligation, but it also respects political discretion by leaving the choice of means to states. This balance is not easy to achieve, but it is essential for maintaining the legitimacy of judicial review.

A third principle is that courts should be attentive to the distributional consequences of their decisions. Climate policies have different effects on different groups, and courts should ensure that their reasoning takes these effects into account. The German Constitutional Court's recognition of the interests of future generations is a model: the Court

acknowledged that current emissions reductions have costs for present generations, but it also recognised that the costs of inaction would be borne disproportionately by future generations. This intergenerational perspective is essential for a just and sustainable climate policy.

V. Conclusion

The use of climate models by courts represents a significant transformation in constitutional adjudication. Courts are no longer merely applying traditional legal doctrines to new facts; they are incorporating scientific frameworks that pre-structure the outcomes of constitutional reasoning. This phenomenon, described as computational constitutionalism, raises profound questions about the separation of powers and the legitimacy of judicial review.

The counter-majoritarian difficulty is not merely a concern about democratic accountability; it is also a concern about the epistemic authority of courts. When courts treat climate models as legally determinative, they transfer epistemic authority from the political branches to the scientific community, and from democratic deliberation to algorithmic calculation. This transfer of epistemic authority subtly reconfigures the constitutional division of labour, limiting legislative and executive discretion not through conventional proportionality balancing, but through the imposition of an "epistemic ceiling" that pre-structures what outcomes remain legally conceivable.

Yet the alternative to judicial engagement is not neutral. The urgency of climate change, the inadequacy of political responses, and the severity of the harms at stake all provide compelling reasons for courts to act. The question is not whether courts should engage with climate science, but how they should do so in a manner that respects democratic legitimacy and institutional competence.

The comparative analysis of *KlimaSeniorinnen* and *Shell* reveals two different models of judicial engagement. The European Court of Human Rights treated a carbon budget as a constitutional benchmark, while the Dutch appellate court treated scientific models as relevant but not determinative. Both approaches have virtues and limitations. The European Court's approach imposes meaningful constraints on states, but it risks overstepping the proper judicial role. The Dutch appellate court's approach respects political discretion, but it may provide insufficient protection for human rights.

The way forward lies in a middle ground: courts should use climate models to inform their reasoning, but they should treat them as advisory rather than determinative. They should specify meaningful constitutional duties while respecting the institutional competence of political branches. They should articulate the normative assumptions underlying their reliance on models, subjecting them to scrutiny and debate. And they should be attentive to the distributional consequences of their decisions, ensuring that the burdens of climate action are fairly shared.

In the age of the Anthropocene, courts have a vital role to play in ensuring that states and corporations address the existential threat of climate change. Yet this role must be exercised with institutional humility, recognising the epistemic limits of judicial reasoning and the democratic legitimacy of political choices. The challenge for constitutional law is to develop doctrines and practices that respect both the urgency of climate action and the integrity of democratic governance. Computational constitutionalism, if properly understood and applied, can be a tool for achieving this balance rather than a threat to it.

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