



POLICY FORUM

CLIMATE POLICY

Legal limits to the use of CO₂ removal

Climate targets that depend heavily on CO₂ removal may contravene international law

By **Rupert F. Stuart-Smith¹, Lavanya Rajamani², Joeri Rogelj^{3,4,5}, Thom Wetzer^{1,2}**

The Intergovernmental Panel on Climate Change (IPCC) has indicated that to hold global warming to 1.5°C, consistent with the goals of the 2015 Paris Agreement, global carbon dioxide (CO₂) emissions need to be reduced to net zero by around mid-century (1). This global goal can be achieved by following various technologically feasible emissions pathways (1), but the range of possible strategies create legal and policy uncertainty regarding the emissions reductions required by states. Pathways differ in their rates of gross and net CO₂ emission reductions, their corresponding dependence on CO₂ removal (CDR) to stay within the cumulative emissions limit imposed by the global temperature goal (2), and the type of CDR they intend to deploy. In the lead up to this year's United Nations (UN) Climate Conference (COP28) in Dubai, we present scientific and legal bases for our argument that emission-reduction pathways that depend heavily on CDR may contravene norms and principles of international law.

CDR IN PARIS-ALIGNED MITIGATION PATHWAYS

Nearly all pathways that limit warming well below 2°C require some CDR (1), but a wide range of mitigation strategies exist that entail similar climate outcomes with radically differing CDR reliance. Some involve deep, immediate cuts in gross CO₂ emissions (see the figure, scenario 1); others would scale up CDR while deemphasizing gross CO₂ emissions cuts (see the figure, scenario 2). In either case, net-zero CO₂ emissions is achieved when CDR offsets remaining gross emissions (see the figure). A recent analysis of emission reduction contributions of the world's wealthiest nations found that they anticipate CDR of ~2.2 bil-

lion tonnes of CO₂ per year (18% of their present emissions) to reach net-zero CO₂ emissions (3).

Without sufficiently deep near-term emissions cuts, temperatures are projected to rise beyond acceptable levels long term. Under “peak-and-decline” pathways, 1.5°C will be temporarily overshoot as cumulative net-CO₂ emissions exceed a 1.5°C-consistent carbon budget (1). Net-negative emissions are then needed to withdraw excess emissions from the atmosphere and return warming to 1.5°C (see the figure, sce-

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nario 3). Almost all pathways assessed in the IPCC's Sixth Assessment Report that return warming to 1.5°C by the end of this century involve some overshoot and net-negative CO₂ emissions after 2050 (1).

CDR therefore serves two main purposes in achieving climate goals: offsetting gross CO₂ emissions to reach net zero and recapturing CO₂ emitted in excess of a carbon budget. Because current emissions are large relative to the remaining carbon budget, emission reductions in the coming decade substantially determine the magnitude of removals required for both uses in subsequent decades. The extent of CDR dependence is consequently a corollary of the rate of near-term emissions reduction.

Cumulatively, countries' policies are incompatible with the Paris Agreement's temperature goal and will result in permanently exceeding 2°C of warming unless vast quantities of CO₂ are removed from the atmosphere (4). However, individual states' dependence on CDR to meet climate targets, and the consistency of that dependence with applicable international legal norms and principles, is currently unknown and unaddressed in literature. Consequently, lawyers and policy advocates lack tools to hold states accountable for excessive CDR reliance because of in-

adequate near-term emissions cuts. This has posed challenges in judicial evaluation of states' mitigation policy. For example, in *Urgenda Foundation v. State of the Netherlands*, the Hague Court of Appeal and the Supreme Court of the Netherlands relied on older emissions pathways premised on lower CDR use to minimize risk. Although understandable in the context, relying on outdated modeling is legally suboptimal. We identify illustrative norms and principles of international law that offer a framework for assessing the legality of emissions pathways.

RISKS OF HIGH CDR DEPENDENCE

Ahead of COP28, the promotion of CDR to accommodate continued fossil fuel use by the United Arab Emirates' COP presidency has dominated public discourse and been characterized as “dangerous” by Christiana Figueres, the former Executive Secretary of the UN Framework Convention on Climate Change (UNFCCC) (5). Excessive CDR reliance carries risks that jeopardize the Paris Agreement's temperature goal and may cause harmful impacts, including those associated with overshooting 1.5°C. These risks and impacts are bases for legal scrutiny of heavily CDR-dependent pathways.

First, technological, legal, social, and economic uncertainty regarding increasing the rate of CDR in coming decades risks nondeployment of CDR. This risk is amplified by the lack of legally binding commitments to scale up CDR to necessary levels. Many of the long-term low-emission development strategies submitted to the UNFCCC acknowledge this uncertainty: 27% rely on bioenergy with carbon capture and storage (BECCS) but note that it is not immediately deployable, and 13% characterize direct air carbon capture and storage (DACCS) as a future option “should its cost be significantly reduced” (6). Second, CO₂ removed by means of CDR may not be stored permanently, which is a particularly acute risk for terrestrial carbon sinks enhanced by afforestation or reforestation and soil carbon storage (7). Third, CDR deployment may cause adverse social, economic, and environmental impacts, including competition with agriculture for land

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(1). Last, peak-and-decline pathways that temporarily exceed temperature limits result in elevated climate change impacts during and after the overshoot period.

THE LEGAL IMPLICATIONS OF CDR DEPENDENCE TO MEET CLIMATE GOALS

Emission-reduction pathways that depend heavily on CDR, with all these incumbent risks, may conflict with norms and principles of international law, spanning treaty and custom. The Paris Agreement sets a direction of travel by identifying a long-term temperature goal (Article 2), and imposing binding obligations on Parties to submit every 5 years nationally determined contributions (NDCs) in line with the global temperature goal [Article 4 (2)], each reflecting a progression on the previous [Article 4 (3)]. Parties are encouraged to explain how their NDCs are fair, ambitious, and contribute to the global temperature goal (8). Parties are also urged to submit long-term low-emission development strategies [Article 4 (19)] “in line with the best available science” and for their NDCs to be aligned to such long-term low-emission development strategies (9). These provisions, and associated COP decisions that provide interpretative context, create a normative pull (a legal direction of travel) toward aligning short-term NDCs with long-term strategies and encouraging states to lay out pathways to the global temperature goal that are rooted in scientific evidence. Emission-reduction pathways that depend heavily on CDR, given their corresponding risks and uncertainties, go against the grain of these provisions.

Heavily CDR-reliant pathways are also incompatible with a human rights approach to achieving climate goals. Indeed, the impacts of climate change on human rights are subject to growing litigation in national and regional courts (10).

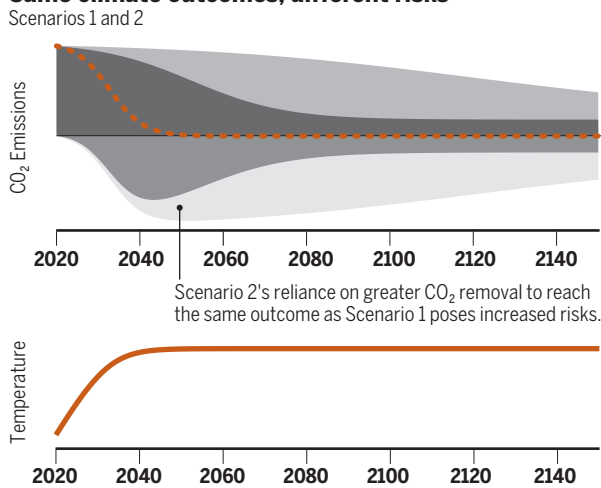
Even if the preambular reference to human rights in the Paris Agreement (Preambular Recital number 11) does not render it a “human rights treaty,” it signals that states need to consider how climate change threatens their ability to meet their obligations under multilateral human rights treaties. Most states have obligations in relation to rights to life, privacy and home life,

CDR risks and climate outcomes

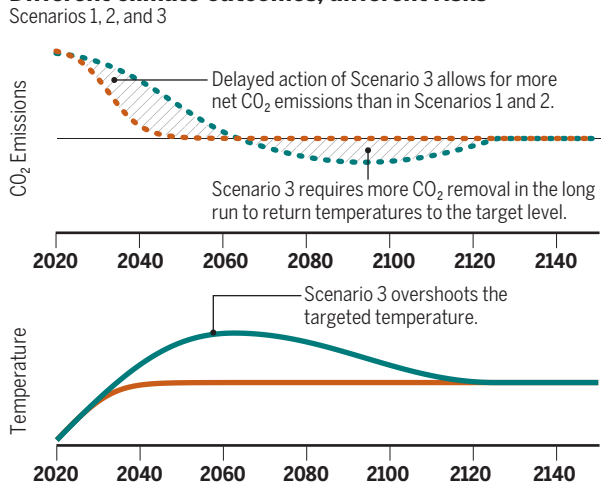
A given net-emissions pathway (and climate outcome) can result from gross emissions of different levels, balanced by corresponding dependence on different levels of CO₂ removal (CDR). For a given climate outcome, greater dependence on CDR to balance larger gross emissions entails additional risks (top two panels). Delayed reductions in net emissions create increased reliance on CDR to remove excess emissions produced in peak-and-decline pathways, resulting in increased climate change impacts during (and for many impacts, after) the temperature overshoot period (bottom two panels).



Same climate outcomes, different risks



Different climate outcomes, different risks



culture, and health, among others, under a range of human rights instruments. As have other UN bodies, the UN Committee on Economic, Social and Cultural Rights noted that failure to prevent foreseeable human rights harm caused by climate change could constitute a breach of states’ obligations to respect, protect, and fulfill all human rights for all people (11)—harms

that may be increased by following higher-overshoot pathways.

In addition to these treaty norms, the customary international law norm of harm prevention is engaged in relation to states’ actions on climate change. This norm requires a high standard of due diligence from states to prevent transboundary environmental harm (12). Among the factors influencing the standard of due diligence in relation to climate harms are the consequences of failing to exercise such due diligence. Given the catastrophic impacts of continuing climate change, due diligence requires states to take urgent, transformative action that has realistic, scientifically backed prospects of stabilizing global temperatures.

CDR-dependent pathways that involve substantial risks are not in keeping with norms and principles of international law, only a few of which are detailed here. These norms and principles can be used to identify limits to states’ reliance on CDR in climate strategies, providing a basis for assessing the adequacy of near-term greenhouse gas mitigation ambition. Further analysis of the quantitative limits implied by these principles could provide a basis for litigation challenging states’ net-zero targets as unimplementable and unreliable and current NDCs as inadequate. These implied limits under international law could complement relevant legal rules in a given jurisdiction to challenge net-zero targets and associated policy packages in domestic courts.

Past litigation demonstrates the effectiveness of such legal strategies. National courts, famously in the 2019 judgment of the Supreme Court of the Netherlands in *Urgenda Foundation v. State of the Netherlands*, and international fora, including in the 2022 decision of the UN Human Rights Committee in the Torres Islands case against Australia (*Billy et al. v. Australia*),

found violations of the rights to private life and to culture, among others, due to inadequate mitigation and/or adaptation action by states. In *Urgenda*, the court’s ruling compelled the Netherlands to reduce emissions by 25% by 2020. Increasingly, courts are also recognizing that choosing pathways that postpone stringent mitigation action and/or rely on potentially costly CDR to be deployed

later threaten intergenerational rights. This was recognized in the 2021 order of the German Constitutional Court in *Neubauer v. Germany*, which declared part of the Federal Climate Protection Act unconstitutional and prompted the German government to enhance its mitigation target from a 55% to a 65% reduction in greenhouse gas emissions by 2030. A human-rights approach, focused on immediate harms to individuals, demands urgent mitigation and adaptation action and militates against risk taking. This includes overshoot pathways that will occasion irreversible and irreparable harm to people and planet.

As in *Neubauer*, states' net-zero targets and NDCs can be challenged as unfair, inter alia, because of the distribution of mitigation action and costs between generations. Such arguments may be used to challenge plans that require substantial net-negative emissions later in the century and leave future generations to retrieve excess emissions. Interdisciplinary research similar in

“...commitments..consistent with some 1.5°C-aligned emission-reduction pathways may still be inconsistent with international law...”

approach to ours synthesized legal expertise and social-science modeling to identify “national fair share” ranges compatible with international law norms and principles and the Paris Agreement’s temperature goal (13) and is being used as a framework by claimants in pending cases before the European Court of Human Rights (such as *Duarte Agostinho v. Portugal* and *KlimaSeniorinnen v. Switzerland*) and in assessments of countries’ climate policies (<https://climateactiontracker.org>).

Such litigation could, if successful, compel more ambitious near-term targets, as it has in the Netherlands as a consequence of *Urgenda*. Even the act of filing cases can lead to reevaluation of near-term target setting in policy circles. Possible causes of action and prospects of success vary between jurisdictions. Nevertheless, norms and principles of international law can provide interpretational context for domestic legal provisions, and interdisciplinary research of the sort we describe can form an evidence base for such cases.

COUNTRIES’ MITIGATION RESPONSIBILITIES

In adopting the Paris Agreement, and through subsequent COP decisions, coun-

tries agreed to maximize collective efforts to limit warming to 1.5°C. Emission-reduction targets should “reflect [a Party’s] highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities” [(14), p. 23]. This implies that emissions should stay within a country’s fair share of the global emissions budget. Although there is no multilaterally agreed framework for assessing fair shares of states, previous literature, cited in some cases by litigants, offers an approach for quantifying states’ fair-share budgets on the basis of a total carbon budget, historical emissions, sustainable development needs, capability to decarbonize, population, and international environmental law principles that pertain to these issues (13).

Meeting fair-share contributions to the Paris Agreement goals requires some CDR to offset (i) gross emissions that remain at the point of net zero and (ii) cumulative net emissions that exceed countries’ fair carbon budgets. However, most states’ submissions to the UNFCCC do not quantify planned gross emissions at net zero, preventing estimation of CDR reliance (6). Moreover, states’ (implicit) CDR dependence derived from emissions produced before reaching net zero in excess of their Paris-aligned carbon budget is neither found in states’ international disclosures (6) nor in national policies. Accordingly, states’ exact dependence on CDR is unknown yet may be crucial for meeting climate targets and present substantial risks.

MOVING FORWARD

The unquantified extent and geographical and technological makeup of states’ CDR dependence limits legal scrutiny of climate targets and should advance calls for enhanced disclosure (7) in countries’ reporting of their emissions mitigation action domestically and to the UNFCCC, including through disaggregating targets for removals and net-emission reductions. Even climate commitments that are conceivably consistent with some 1.5°C-aligned emission-reduction pathways may still be inconsistent with international law norms because all but the most ambitious cuts in gross emissions create high CDR dependence. The estimated extent of states’ dependence on CDR does not conform to international law norms and principles. Doing so would require far steeper near-term emissions cuts than are planned under most national policies.

Our analysis also demonstrates the need for interdisciplinary scientific and legal re-

search that clarifies the appropriateness of and risks associated with specific emission-reduction pathways. Such research would provide bases for legal scrutiny, including by quantifying implied state and corporate CDR dependence. Moreover, legal analysis could identify a range of states’ CDR reliance that is consistent with interpretation of international and domestic laws, given the associated risks. Improved disclosure, coupled with further scientific and legal research, will clarify how states need to accelerate emission reductions. Otherwise, given the recent growth in climate-related legal action (15), states’ CDR dependence may be the next aspect of climate (in)action to be challenged in court. ■

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