

Three Pathways to Nonuse Agreement(s) on Solar Geoengineering

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Recent years have seen increasing calls by a few influential institutions and scientists, largely from the Global North, to explore “solar geoengineering,” a set of speculative technologies that would reflect parts of the incoming sunlight back into space and, if deployed at planetary scale, seek to have a cooling effect.¹ There are numerous concerns about the development of such speculative technologies, notably regarding the unresolved questions of global governance, the many ecological risks and uncertainties, and the implications for global justice.² These concerns have led to a call by over 520 academics from more than sixty countries, supported by over two thousand civil society organizations, for an international nonuse agreement on solar geoengineering.³ The proposed nonuse agreement would commit governments to not developing or deploying technologies for solar geoengineering; to not providing public funding for their development or permitting outdoor experimentation; and to not granting patents to private actors or supporting the development or deployment

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of such technologies in international institutions.⁴ This essay takes as its starting point the proposition advanced by this call for nonuse that “solar geoengineering at planetary scale is not governable in a globally inclusive and just manner within the current international political system,”⁵ and, as such, that the ethically sound approach is to pursue governance that prevents the development and use of planetary-scale solar geoengineering technologies.

One aspect that has given rise to much political and academic debate is the feasibility of realizing such a nonuse agreement. For example, how could negotiations for a nonuse agreement be initiated, where and by whom could this be done, and what if some powerful states refuse to participate in a broadly accepted international agreement, even if eventually negotiated by countries? How could a globally applicable nonuse agreement then be developed, if at all?

Our contribution to this *Ethics & International Affairs* roundtable addresses these questions by exploring various potential nontreaty, or pretreaty, pathways toward more restrictive global governance of solar geoengineering. We draw lessons from other globally applicable regimes that did not originate from top-down advocacy by powerful states. Examples include the role of transnational networks of cities in climate change adaptation and mitigation governance and policymaking, the bottom-up evolution of the Anti-Personnel Landmines Convention,⁶ and the rapid proliferation of bans on plastic bags or phaseout dates for coal burning.⁷

All these pathways toward the nonuse of risky or harmful substances or activities have relied on a host of public, private, and civil society actors—from both the Global South and the Global North—coming together to voice public concern and devise elements of restrictive governance unilaterally or collectively. These more bottom-up approaches may emerge from diverse sources of leadership at national and subnational scales, from broad coalitions of civil society actors as well as regional groups of states and organizations. By outlining various such pathways, this essay shows the political feasibility of nonuse agreements on solar geoengineering *even in the absence of universal engagement from powerful actors*, as well as their potential to forge global norms of nonuse.

Our analysis draws on an emerging but robust literature on changing normative politics at state, transnational, and global scales that seeks to offer effective responses to climate change and support a just energy transition.⁸ This body of research, like our essay, is interested in the processes and the potential for rapid normative, legal, and behavioral change in global politics and governance, in the face of challenges presented by accelerating climate change.

Drawing inspiration from these developments, this essay offers three illustrative pathways through which a nonuse norm for solar geoengineering could emerge and become diffused and institutionalized in global climate politics. These pathways are: (1) civil society-led transnational approaches; (2) regionally led state and civil society hybrid approaches; and (3) like-minded or “Schengen-style” club initiatives led by states. All three pathways could result in an agreement, or multiple agreements, that are less centralized and not based on the existence of a singular global treaty. While such pathways could eventually lead to a centralized, legally binding international treaty within the United Nations system, they need not start that way, nor do they require that such an instrument be the ultimate objective of all participating actors. In short, we find that realizing a global nonuse norm for solar geoengineering through multiple pathways could be possible without the need to rely on a single global decision-making event, process, or body.

PATHWAY 1: CIVIL SOCIETY–LED TRANSNATIONAL APPROACHES

The first pathway to the nonuse of solar geoengineering would be norm change led by civil society organizations that would emerge outside the traditional inter-governmental system. This pathway to a global ban on the development and deployment of solar geoengineering technologies would rely on the active involvement of multiple stakeholders from the public, private, and civil society sectors, spanning both the Global South and the Global North. It would involve their engagement in expressing public concern and—unilaterally or collectively—advancing elements of a restrictive or prohibitory governance framework. For instance, if a global coalition of national academies, public and private research funders, and civil society groups were to come together to convincingly demand restrictions on solar geoengineering within their spheres of influence, a robust and polycentric regime of nonuse of solar geoengineering could emerge. Such a broad movement could eventually include like-minded governments in both the Global South and Global North that would formally adopt restrictive policies and transpose them into domestic and possibly international law. This process could be further supported by transnational and civil society initiatives that would diffuse an emerging global nonuse norm on solar geoengineering; for instance, through working with national and international funding agencies and organizations to further curtail research and development on solar geoengineering technologies. This pathway to a global nonuse agreement would be marked by a variety of

institutional arrangements and a global diffusion of debate and policymaking among very different types of states, public and private funding organizations, civil society groups, and private sector actors. For example, powerful networks of civil society organizations, universities, national academies of science, and states might emerge and eventually declare and implement restrictions on the exploration of technologies for solar geoengineering.

There are numerous precedents for such a pathway. Examples include the highly networked involvement of cities in climate change politics,⁹ the development of the global Anti-Personnel Landmines Convention, the rapid international proliferation of bans on plastic bags,¹⁰ and phaseout dates for coal burning. The 1997 landmines convention offers a particularly compelling illustration of how a global treaty to ban the production, transfer, and deployment of a technology, in this case anti-personnel landmines, emerged through a civil society-led international nonuse movement. In response to lack of decisive state action, six NGOs came together in 1992 to establish the International Campaign to Ban Landmines, which took upon itself the task to advocate tirelessly for a global shift toward a nonuse norm in this area. A nonuse movement started to crystallize and rapidly expanded to include not only ever-more-transnational and domestic NGOs but also UN staff and agencies, as well as prominent human rights and development organizations and a small group of sponsoring states,¹¹ illustrating this particular pathway to global norm development.

Looking at the broader historical context of global governance, it is evident that civil society and lead-state sponsorship often play a pivotal role in the early development of international prohibition treaties.¹² The example of the landmines convention further underscores that restrictive global governance norms and institutional arrangements can be constructed even in the face of opposition from powerful actors, such as the United States, which has consistently opposed key provisions in the treaty and continues to refuse to ratify it. Furthermore, such global governance frameworks have the potential to influence U.S. policy both on the international stage and in domestic practice. This is evident from the fact that even as the United States chooses to remain outside the landmine prohibition regime, its policies on anti-personnel landmines have become more restrictive over time, in response to pressures from domestic and international advocates of a universal anti-personnel landmines ban, underpinned by a decisive normative shift in this direction.¹³ Recently, scholars of global governance have become more interested in “aspirational politics,” in which normative change in

the international system can be driven by “lofty goals, change over time, and transformation through imagination.”¹⁴ Civil society actors, working in concert with some public- and private-sector actors, are central to such aspirational politics in transnational and global governance.

Some movement toward aspirational, civil society-led demands for restrictions on solar geoengineering can already be seen. For example, at the twenty-eighth Conference of the Parties of the United Nations Framework Convention on Climate Change in 2023, several civil society actors fostered public debate by proposing a nonuse agreement on solar geoengineering as a global policy. In cross-constituency demonstrations, side events, press conferences, and statements issued before and during the Conference of the Parties, various civil society organizations, academics, and activists made clear their view that “techno-fixes,” including solar geoengineering, are dangerous distractions from the climate action urgently needed in this critical decade.¹⁵ For example, the Women & Gender Constituency—one of the nine stakeholder groups at the climate convention—expressed in its formal interventions deep concern about the promotion of speculative, risky, and dangerous technologies such as solar geoengineering. The Environmental NGO Constituency, another stakeholder group that comprises the global Climate Action Network, made up of thousands of civil society members from across the globe, and the Global Campaign to Demand Climate Justice organized actions against solar geoengineering. The Climate Action Network has referred to solar geoengineering technologies as “false solutions” and openly called for a global nonuse agreement.¹⁶ In short, NGOs and civil society, in conjunction with many scientists and scholars, are already prominent voices in the critique of solar geoengineering’s risks and inappropriateness as a policy option and are thus key actors in the push for a nonuse norm. As with the case of the Anti-Personnel Landmines Convention, this pressure could eventually lead to declarations or even firm decisions by governments, parliaments, national funding agencies, or UN bodies to help institutionalize a global norm for the nonuse of solar geoengineering.

PATHWAY 2: REGIONALLY LED STATE AND CIVIL SOCIETY HYBRID INITIATIVES

The second pathway to developing a nonuse norm would rely on formal or informal regional coalitions of members of civil society, supportive states, and regional

international organizations, such as the European Union and the African Union. Member states within these regional organizations often share common values and geopolitical interests, as reflected in their coordinated stances in multilateral negotiations. The interest of the member states of the EU and the AU to act in concert in promoting a solar geoengineering nonuse norm might derive from their shared vulnerability to the potential ecological and geopolitical risks associated with planetary-scale solar geoengineering interventions. Developments in some regional and international fora (such as the UN) to date suggest that some African government officials may already be converging toward support for a nonuse mechanism on solar geoengineering, in response to a growing normalization of this speculative technology as a future climate policy option within certain scientific and policy circles, led by the United States. The AU could play an important role in further fostering regional debate or consensus by encouraging its member states to adopt domestic nonuse policies and advocating for the inclusion of the nonuse option on solar geoengineering within UN bodies. In a significant development that took place in August 2023, a decision by the African Ministerial Conference on the Environment (AMCEN) called for “a global governance mechanism for non-use of solar radiation management,”¹⁷ hence revealing its support for a broader normative shift toward a nonuse agreement. At the United Nations Environment Assembly (UNEA) in February 2024, during a debate on a potential resolution on solar radiation modification, the African group of countries reiterated its support for a nonuse mechanism for solar geoengineering and called for acknowledgment of its earlier AMCEN decision in any resolution on solar radiation modification to emerge from the UNEA.¹⁸ These developments suggest that a regionally shared, pan-African position in favor of nonuse may emerge.

Regional efforts could culminate in a regional treaty inspired by successful models such as the Bamako Convention, which prohibits the import of hazardous waste into Africa. Originating as a response to the shortcomings of the 1989 Basel Convention in preventing waste export to Africa, the Bamako Convention was negotiated by twelve nations of the Organisation of African Unity (which later became the African Union) with the support of global NGOs.¹⁹ Following its inception in 1991, the Bamako Convention entered into force in 1998 and currently has twenty-seven parties, representing about half of African states.

This concerted regional response to environmental challenges suggests that a similar regional approach is conceivable in the context of the nonuse or prohibitory governance of solar geoengineering. This may be the case particularly in

Africa, Latin America, and Europe, where civil society concern and critique regarding solar geoengineering is robust, and where such critique and concern has also been taken up by some state officials. Furthermore, African and Latin American countries share colonial histories that lead them to voice strong concerns over sovereign control of their territories and resources. In Latin America, a commercially driven solar geoengineering outdoor experiment that was conducted over Mexican territory by U.S.-based start-up Make Sunsets in 2023 provided strong evidence of this. The experiment sparked an immediate national ban on solar geoengineering experiments in the country.²⁰ The Mexican government's response to the aerosol injection experiments conducted by Make Sunsets over its territory without its knowledge or consent could potentially have a ripple effect across the region and spur further regional cooperation on this sensitive and contested issue. This was evident during the recent UNEA deliberations on solar radiation modification referred to above, where Mexico called strongly and vocally for condemnation by the international community of such unauthorized activities on the basis that they were an unacceptable infringement of its sovereignty.

Intra-European collaboration on promoting a potential nonuse norm can similarly leverage its robust regional multilateral institutions. Depending on domestic political dynamics, the European Parliament or individual European governments may issue declarations or take other steps to support nonuse measures. By leveraging regional cooperation and consensus, these areas, together constituting a majority of the world's countries, have the potential to develop and implement proactive measures, possibly leading to the establishment of regional agreements on the nonuse of solar geoengineering technologies.

PATHWAY 3: A LIKE-MINDED OR "SCHENGEN-STYLE" CLUB APPROACH

A third potential pathway hinges on the initiation of debates and advocacy efforts by domestic and transnational actors that strategically influence the political agendas of individual countries, one by one. A precedent for such an approach can be found in the 1985 signing of the Schengen Agreement, in which Belgium, France, Germany, Luxembourg, and the Netherlands agreed to ease restrictions on the movement of individuals and to gradually eliminate further restrictions relating to various aspects of their shared borders. This landmark agreement marked the genesis of an expanding Schengen Area that

currently has twenty-seven members with more states planning and aspiring to join. This model of “like-minded” coalitions forming within global, multilateral negotiating forums also has other historical precedents, particularly in the area of multilateral agreements relating to national security, such as those restricting the research, development, transfer, deployment, and use of certain chemical and biological weapons, as well as certain nuclear technologies and nuclear weapons testing.²¹ Notably, the Nuclear Non-Proliferation Treaty (NPT), initiated by negotiations involving only eighteen countries from diverse geopolitical orientations, now boasts the support of 191 parties. Embedded in the UN system, NPT institutions feature secretariats with intricate rules; decision-making protocols; and extensive procedures for reporting, monitoring, evaluation, and inspection, serving as templates for governing the nonuse or prohibition of other potentially dangerous technologies.

Drawing from this historical perspective, one might envision a future scenario where several like-minded countries in Latin America, the Pacific Islands, Europe, and Africa, for example, collaborate to establish an initial multilateral framework that restricts the development and deployment of solar geoengineering technologies. Such a coalition could then invite other states to join, fostering a step-by-step process leading to the discussion, negotiation, adoption, ratification, and eventual enforcement of a binding global treaty—a trajectory that would be reminiscent of the NPT. Importantly, the explicit bans or significant restrictions on research and development related to chemical, biological, and nuclear weapons do not hinder research in other areas of chemical, biological, and nuclear technologies, demonstrating that states can effectively regulate and constrain some activities and technologies while facilitating others.

The examples above suggest that rather than entertaining hypothetical objections based on potential future needs for such weapons, states opted for a precautionary approach, acknowledging that the strict prohibitory governance and outright bans of certain chemical, biological, and nuclear technologies are essential to prevent their misuse. This approach reflects a shared conviction among policymakers and expert bodies that increased capabilities in these areas escalate the likelihood of their weaponized use. As noted above, some states opposed to the acceleration of solar geoengineering development have already started taking a position in global fora, such as at the 2024 UNEA, to prevent resolutions that may unintentionally normalize solar geoengineering as a climate policy option.²² More steps in this direction are conceivable.

CONCLUSION

Many critics of solar geoengineering, including ourselves, agree that there is simply no ethically sound, just, and effective global governance system whereby a few humans can safely and for the greater good of all “manage” the earth’s stratosphere and its climate systems through artificially tinkering with incoming solar radiation.²³ This essay advances the proposition that an urgently needed nonuse regime for speculative and highly risky solar geoengineering technologies can emerge through multiple pathways—not only through a global top-down intergovernmental treaty. Alternative pathways could instead involve decentralized, bottom-up, and regional regulatory initiatives from state and nonstate actors. Past precedent in international relations and global governance, as well as robust research in the social sciences, shows that multiple pathways to restrictive or prohibitory transnational, interstate, and global governance exist. Despite the current inclination of some powerful states, such as the United States, to endorse and normalize the research about and potential development of solar geoengineering technologies, it is essential to recognize that multiple prospects for instituting restrictions on such technologies at various scales of governance exist. Normative, legal, and behavioral change in international politics is always contentious. But such contention is part of the various processes and pathways of change. The presence of a few powerful governments in opposing institutional change need not be an insurmountable barrier to achieving societally desired normative and legal change.

Our discussion here instead underscores the need for advocates to draw important lessons from past and present efforts to construct meaningful, effective, and ethical global governance institutions. The three potential pathways that we have elaborated here for global governance to restrict solar geoengineering all draw on past experiences in international governance. We believe, therefore, that all three pathways also point to possible avenues of political action for a future global regime restricting the use of solar geoengineering technologies. Instead of committing our world and future generations to decades, if not centuries, of possibly ill-fated planetary-scale solar geoengineering programs, the focus of our attention must be on the urgent reduction of the emissions of all greenhouse gases rapidly enough to achieve globally agreed upon temperature targets, while ratcheting up political and financial support for a just transition away from fossil fuels worldwide.

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Abstract: Recent years have seen increasing calls by a few scientists, largely from the Global North, to explore “solar geoengineering,” a set of speculative technologies that would reflect parts of incoming sunlight back into space and, if deployed at planetary scale, have an average cooling effect. Numerous concerns about the development of such speculative technologies include the many ecological risks and uncertainties as well as unresolved questions of global governance and global justice. This essay starts with the premise that solar geoengineering at planetary scale is unlikely to be governable in a globally inclusive and just manner. Thus, the ethically sound approach is to pursue governance that leads to the nonuse of planetary solar geoengineering. Yet is such a prohibitory agreement feasible, in the face of possible opposition by a few powerful states and other interests? Drawing on social science research and a host of existing transnational and international governance arrangements, this

essay offers three illustrative pathways through which a nonuse norm for solar geoengineering could emerge and become diffused and institutionalized in global politics: (1) civil society-led transnational approaches; (2) regionally led state and civil society hybrid approaches; and (3) like-minded or “Schengen-style” club initiatives led by states.

Keywords: global governance, solar geoengineering, solar radiation modification, nonuse agreement, climate change, norms